The HANDBOOKS *of* OPERATIVE SURGERY

THE STOMACH AND DUODENUM

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Surgery of the

STOMACH AND DUODENUM

Dedicated

to

ARTHUR W ALLEN, M D

An able teacher a stern critic and

a loyal friend

Reprinted October 1952

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Third edition 1959

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Preface to Third Edition

This new edition includes significant advances in the surgery of the stomach and duodenum that have emerged in the past four years An expansion of the text has made it possible to include as well a brief discussion of other unusual diseases of the stomach that are amenable to surgical attack The import of increasing surgical experience on the indications for various operative procedures has been assessed Finally specific attention now is given to hemorrhage due to portal hypertension since methods for its control must be the concern of surgeons who are responsible for the treatment of gross bleeding from the upper gastrointestinal tract Despite the elaboration of textual material the book remains in essence an exposition of surgical technics

—Claude E Welch

Preface to Second Edition

The enthusiastic response that greeted this handbook has made a second edition necessary Because of numerous requests for additional information the subject matter has been extended and several new plates included

Surgical styles and technics change continually In this edition it will be noted that certain operations have become more popu

lar and others have receded in significance while some new procedures have been described Popularity does not imply permanence but the inclusion of this material is necessary for the student to appreciate the changing trends of surgical opinion Meanwhile the original format has not been changed Emphasis on technics has been maintained rather than on discussion Finally, a historical summary has been added so that the young surgeon may gain a proper perspective of the development of gastric surgery

Preface to First Edition

IN THIS HANDBOOK of operative surgery the most common and important operations that are performed on the stomach and duodenum have been selected for discussion The book is planned as a practical guide particularly for younger surgeons It is not designed as a complete description of all surgical diseases of these viscera and a number of the rarer operations have been excluded

Severe limitations have been imposed on the text to allow more space for the illustrations hence discussion of the various procedures is necessarily brief and therefore quite often didactic The recommended operations are those currently in use in the Massachusetts General Hospital where on the ward service the major part of the surgery must be performed by the resident staff Usually alternative technics that may be preferred in other clinics are included A complete discussion of the relative merits of these competing methods is beyond the scope of this handbook but emphasis is placed on the indications for various procedures and on the selection of safe rather than brilliant operations

It will be noted that the use of transthoracic approaches is advised in many instances The gastric surgeon should not be limited to use of an abdominal approach any more than a gynecologist or

obstetrician is limited to the perineum Consequently, the technics that follow both types of incisions as they are applied to the stomach and duodenum are included

It is recognized that the subject matter of each volume in this series must overlap slightly In such instances the development of parallel or divergent points of view by the various authors will be of great interest to the reader

Lack of space makes it impossible to refer to the many individual surgeons who have added to our knowledge of the stomach and duodenum As a slight atonement a brief bibliography is included so that reference can be made to the more important articles in their original form

Although gastric surgery cannot be reduced to a summation of technical maneuvers it is clear that the important feature of this handbook is the clear and accurate portrayal of the steps in the various operations Mrs Muriel McLatchie Miller has contributed the artwork to this volume Many of her original sketches made in the operating room have been especially modified for this text In other instances in which technics not used in this hospital are illustrated acknowledgment is made to other authors both on the plates and in the references The author extends his thanks to Mrs Miller to Dr Richard H Sweet for many helpful suggestions to Dr Robert Green for criticism of anatomical details and to Mrs Grace Bosworth for her aid in preparation of the manuscript

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SECTION 1

Anatomy of Stomach and Duodenum

STOMACH —The cardia is an anatomical landmark and a true but feeble sphincter that designates the upper end of the stomach where it merges into the esophagus The lower end of the stomach is marked externally by the pyloric vein and just beneath it the pylorus can be palpated Mobilization of the normal stomach requires the freeing of the greater and lesser curvatures but in various pathological conditions the posterior wall may be adherent as well The greater curvature may be freed either by removal of the omentum from the transverse colon turning all or part of the omentum upward with the stomach or by section of the various branches of the gastroepiploic vessels as they enter the wall of the stomach To mobilize the lesser curvature the left and right gastric vessels are divided

The stomach is subdivided into the fundus body and pyloric antrum Strictly speaking the fundus is that part of the stomach located above the level of the cardia while the distal 2 in of stomach comprise the prepyloric area or pyloric antrum The remainder forms the body of the stomach The pylorus varies from a true muscular canal nearly 1 in in length to a widely patulous opening

DUODENUM —The duodenum is divided into four portions the transverse (the "cap") descending lower transverse and ascending All but the first portion is retroperitoneal The common bile and pancreatic ducts empty into the duodenum 7–10 cm beyond the pylorus, but this distance may be found shortened considerably by the inflammation that accompanies a duodenal ulcer An accessory pancreatic duct is frequently present and empties into the duodenum about 2 cm above the ampulla of Vater The fourth portion of the duodenum is crossed anteriorly by the superior mesenteric vessels and posteriorly lies on the body of the second lumbar vertebra

Plate 1 illustrates the arterial and venous blood supply of the stomach and duodenum The usual distribution is demonstrated but variations are common enough to make careful dissections necessary during any operation

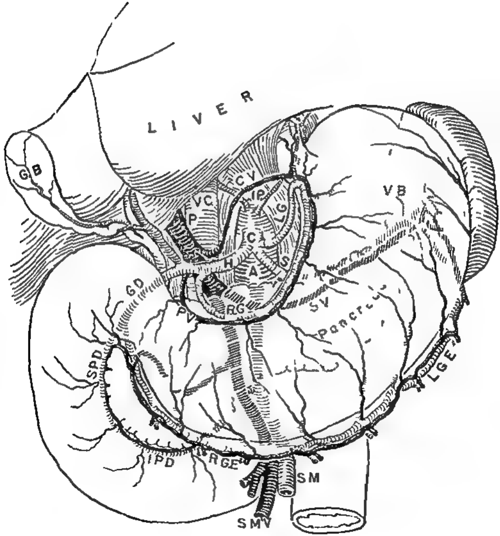
The *inferior phrenic arteries* (*IP*) usually arise as separate trunks from the aorta (*A*) just below the diaphragm The right phrenic ascends on the under surface of the right diaphragm The left crosses behind the esophagus and is distributed to the left side of the diaphragm One large branch crosses anterior to the esophagus in the substance of the diaphragm this must be ligated when the diaphragm is opened

The *celiac axis* (*C*) divides into the left gastric splenic and hepatic arteries The left gastric artery (*LG*) provides a large descending branch to the left side of the lesser curvature and a smaller ascending branch to the lower end of the esophagus In 40 per cent of cases an anomalous branch extends in the upper portion of the gastrohepatic ligament to the porta hepatis The splenic artery (*S*) gives origin to the left gastroepiploic (*LGE*), the vasa brevia (*VB*) to the fundus and to small pancreatic branches From the hepatic artery (*H*) arise the right gastric (*RG*) and the gastroduodenal (*GD*) which divides into the right gastroepiploic (*RGE*) and superior pancreaticoduodenal (*SPD*) arteries The gastroepiploic vessels supply the corresponding portion of the greater curvature, while the superior pancreaticoduodenal anastomoses freely with the inferior branch to supply duodenum and head of the pancreas

The *superior mesenteric artery* (*SM*) lies to the left of the corresponding vein and gives origin to the inferior pancreaticoduodenal artery (*IPD*)

The venous drainage roughly follows the arterial supply The pyloric vein (*PV*) corresponding to the right gastric artery is usually very small Most of the blood from the lesser curvature drains via the coronary vein (*CV*) into the portal (*P*) near the junction of splenic (*SV*) and their superior mesenteric veins (*SMV*) The vena cava (*VC*) receives no blood from the stomach or duodenum

Complete devitalization of the stomach is possible if all the main arteries are divided close to the gastric wall Consequently whenever the stomach is resected an adequate arterial supply must be maintained for the gastric remnant


LIVER
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Pancreas
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SPD
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IPD
RGE
SM
SMV

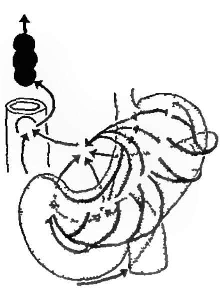
[20] *Lymphatic Drainage*

Afferent lymphatics from the gastric wall drain into several groups of superficial nodes along the curvatures From them, lymphatics drain into the deep system along the celiac axis and porta hepatis and thence into the receptaculum chyli Unfortunately, the superficial lymphatics often by pass the superficial nodes completely, so that metastases from gastric cancer may be found in surgically inaccessible nodes while those along the curvatures are not involved by disease

The superficial nodes of the stomach are divided into six groups The paracardial nodes (*PC*) surround the cardia as a necklace The first metastases from carcinoma of the lower esophagus or cardia of the stomach are often found here The left gastric nodes (*LG*) extend along the left gastric artery to its origin and can be removed en bloc with the artery The splenic nodes (*S*) at the hilum of the spleen require splenectomy for adequate excision The right gastric nodes (*RG*) are found along the corresponding artery The gastroepiploic group (*GE*) along the greater curvature also collects afferents from the great omentum so that retrograde metastases into this structure are not uncommon The subpyloric nodes (*SP*) are found just beneath the pylorus

The deep nodes are difficult or impossible to remove at the time of gastrectomy They lie on the celiac axis (*C*) along the hepatic artery (*H*) and within the head of the pancreas (*P*)

The lymphatic drainage of the duodenum is collected into vessels and nodes that lie along the inner surface of the duodenum particularly near the origins of the superior and inferior pancreaticoduodenal arteries (*D*)

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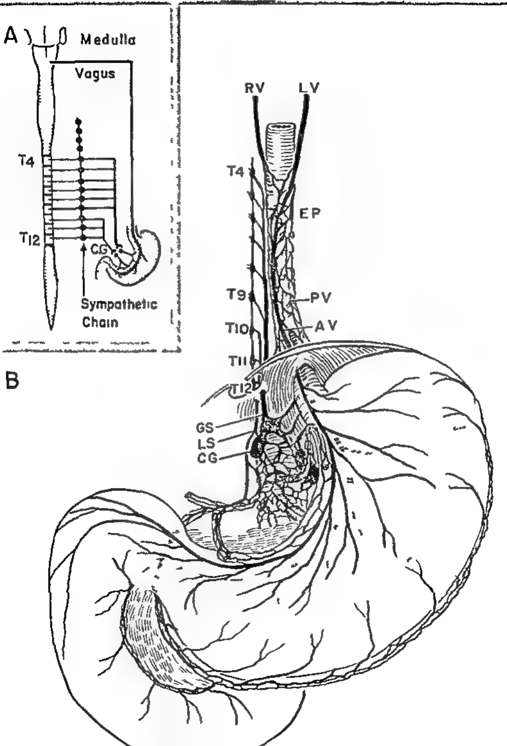
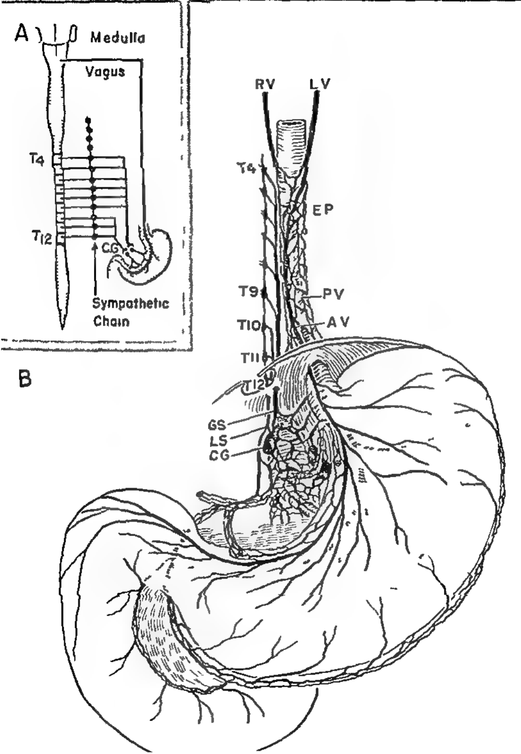

A
Medulla
Vagus
T4
T12
CG
Sympathetic
Chain
B
RV
LV
T4
EP
T9
PV
T10
AV
T11
T12
GS
LS
CG

The nerve supply of the stomach has become of practical as well as theoretical importance in recent years with the result that the methods and results of gastric denervation must be appreciated by the general surgeon

The stomach is innervated by the sympathetic nerves and the vagi as illustrated diagrammatically in Plate 3, *A* The sympathetic nerves function chiefly as afferent fibers reaching the stomach and duodenum *via the right and left splanchnic nerves through the celiac* ganglions (*CG*) The greater splanchnic (*GS*) is formed from fibers leaving the dorsal sympathetic chain from the fourth to twelfth thoracic ganglions except when the lesser splanchnic nerve (*LS*) is present, which arises from the tenth to twelfth thoracic ganglions Complete bilateral sympathetic denervation produces no important motor or secretory changes but stops pain sensations thus gastric or duodenal ulcers may form and bleed or perforate without warning

Removal of the vagus nerves will however, influence the stomach and duodenum more seriously Anatomically variations in the formation of the vagus trunks are common In general the vagus nerves descending from the region of the bronchi form an anterior and posterior esophageal plexus (*EP*) At a lower level the various fibers reunite forming anterior (*AV*) and posterior trunks (*PV*) Most of the fibers of the left nerve (*LV*) pass to the anterior trunk and of the right (*RV*) to the posterior These trunks course along the lower 5–8 cm of esophagus and pass through the hiatus to enter the gastric wall about 2 cm below the diaphragm

Interruption of one vagus trunk at the level of the diaphragm has no demonstrable physiological effect Bilateral vagotomy produces profound motor and secretory changes in the stomach That these changes fail to occur in about 10 per cent of all vagotomies suggests *not only that anatomically complete denervation is difficult to obtain* but that cholinergic fibers may reach the stomach by other unknown pathways Important effects of vagus section include a reduction in the volume and acidity of gastric contents particularly in patients with duodenal ulcer In all cases there is a decrease in gastric tonus and *motility which* with increased pyloric spasm leads to delay in the emptying time These motility changes are so important that the vagus nerves should never be sacrificed unnecessarily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SECTION 2

Historical Summary

A BRIEF SUMMARY of the development of surgery of the stomach and duodenum must include the contributions of many master surgeons. A historical perspective can be gained most effectively by noting the chronological sequence of these various innovations. The methods mentioned briefly here will be discussed more fully in later sections.

Gastric surgery has developed within the past 80 years. In 1875, the British surgeon Jones successfully accomplished a gastrostomy. Gastric resection for cancer was attempted in 1879 by Pean and in 1880 by Rydygier, but both of their patients died. Billroth, on Jan. 29, 1881, performed the first successful gastric resection. This was also done for cancer, and the patient lived for four months thereafter. Continuity of the gastrointestinal tract was re-established by a gastroduodenostomy. Ever since then, such anastomoses have been specified as Billroth I procedures (Plates 42 and 43). In 1885, Billroth planned a two-stage gastric resection for a patient in poor condition in whom an anterior gastroenterostomy was to be done first, to be followed later by resection of the stomach distal to the anastomosis. However, since the patient stood the operation well, the entire operation was carried out in one stage. This became the Billroth II operation, and thereafter all gastric resections in which the stomach is anastomosed to the jejunum have been known as Billroth II procedures (Plates 44 and 45.)

In the same year as Billroth's first gastric resection, Woelfler did the first gastroenterostomy. This also was performed for cancer. He placed the anastomosis in an antecolic position with the afferent loop attached to the anterior wall of the stomach to the right of the efferent loop.

Thus with the exception of total gastrectomy and partial proximal gastrectomy the standard operations for cancer of the stomach were established within a few years Numerous modifications of these procedures were made thereafter

GASTROSTOMY —The simplest of the standard gastric operations gastrostomy enjoyed great popularity until recently Witzel introduced a successful catheter gastrostomy in 1891 (Plate 20) Later methods involving a catheter but using different methods of suture were developed by Stamm (1894) and Kader (1896) (Plate 21) *To eliminate catheters Janeway (1913) made a tube from a flap* of the gastric wall (Plate 22) Beck in 1905 and Jianu in 1912 described an exceptionally long gastric tube that could be compressed by bringing it behind a skin bridge (Plate 23) Spivack in 1929 devised a valvular stoma which prevented leakage of gastric contents (Plate 24)

GASTROENTEROSTOMY —Gastroenterostomy was subjected to innumerable modifications involving the location of the stoma the relation of the afferent and efferent loops in an iso or "antiperistaltic" fashion and the length of the afferent loop Most of these variations were made in the hope that the severe and persistent vomiting which often followed this operation could be avoided Relief from this complication was finally accomplished by Braun who in 1892 made a lateral anastomosis between the afferent and efferent loops leading to the gastroenterostomy (Plate [illegible] C) Roux (1897) established his Y anastomosis for the same reason the jejunum was divided the distal end anastomosed to the stomach and the proximal end to the jejunum at a lower level This type of anastomosis is used in many other anatomical locations in Plate 63 *S–W* it is shown after a total gastrectomy Finally the most satisfactory type of gastrojejunostomy was developed by Petersen and popularized later by Mayo and Moynihan This is the short loop postcolic anastomosis described in Plate 36

GASTRIC RESECTION —The Billroth I operation achieved some notoriety in early years because of leakage from the "fatal angle" where the lesser curvature meets the gastroduodenostomy To avoid this von Haberer (1922) and Finney (1923) sutured the entire open end of the stomach to the duodenum (Plate 43 *B*) Kocher (1893) implanted the duodenum into the posterior wall of the stomach (Plate 43 *D*) Meanwhile Schoemaker (1911) developed

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to von Eiselsberg s exclusion operation for cancer and by Bancroft who added an excision of the antral mucosa (Plate 48) A two stage gastrectomy has been devised by McKittrick, Moore and Warren (Plates 46 and 47)

Another series of operations for ulcer proposes to lower gastric acidity by removal of a large segment of stomach containing acid secreting cells Connell did such an operation in 1929 that he termed a fundusectomy Somewhat similar but more extensive operations are Wangensteen s tubular resection (1940) and his sleeve resection (1952) (Plate 54)

Vagotomy combined with posterior gastroenterostomy was introduced by Dragstedt in 1943 (Plate 40) Although sporadic instances of vagotomy had been described before this operation was never standardized or popularized until Dragstedt s work appeared A meticulous transthoracic technic was developed by Moore (Plate 41) in 1944

OTHER OPERATIONS FOR CANCER —Total gastrectomy was first successfully carried out by Schlatter in 1897 Among the technical modifications that demand mention are Schloffer s enteroanastomosis between the anastomotic jejunal limbs and Graham s method of total gastrectomy (Plate 62) Replacement of the gastric pouch by other viscera was introduced by Hunnicutt (1949) and Lee (1951) who employed segments of the colon (Plate 61)

Proximal gastric resection for cancer was first done successfully by Zaaiger in three stages in 1913 The first successful transpleural operation in one stage was reported by Braun (1916) In America Marshall and Adams and Phemister were pioneers

OTHER OPERATIONS —Other pioneer contributions of major importance include Rammstedt s operation for congenital pyloric stenosis in 1912 (Plate 14) Heller s operation for cardiospasm in 1913 (Plate 35) and Whipple s operation for carcinoma of the duodenum and head of the pancreas in 1935 (Plate 67)

The repair of hiatus hernias through a transabdominal approach has been developed by Harrington (Plate 30) and through a transthoracic approach by Sweet and Allison (Plate 31)

A complete historical review by Waugh and Hood may be consulted

a method of excision whereby the entire lesser curvature was removed.

Billroth II variations have been more numerous and important. Antecolic anastomoses predominated in the early variations. Kronlein (1888) anastomosed the entire open end of the stomach to the jejunum, whereas von Eiselsberg (1889) closed the upper end of the stomach (Plate 44, C). In both of these procedures the afferent loop was attached in an antecolic position to the lesser curvature. Later Moynihan (1923) reversed the position of the loops placing the afferent loop at the greater curvature (Plate 44, *D*).

The retrocolic anastomoses were initiated by Hofmeister, who, in 1896, closed the upper portion of the opening in the stomach and anastomosed the jejunum with the afferent loop toward the lesser curvature (Plate 44, A). The same procedure was advocated by Finsterer in 1914. Meanwhile Polya (1911) had carried out a similar operation except that he anastomosed the jejunum to the entire open end of the stomach (Plate 44, *B*).

A palliative operation for gastric cancer was developed by von Eiselsberg in 1895. He divided the stomach above the tumor, closed the distal stomach and anastomosed the proximal stomach to the jejunum (Plates 44, F, and 65). This became the first "resection for exclusion"; it is still used occasionally for inoperable cancer but has also been modified and applied to duodenal ulcer.

Operations for Duodenal and Gastric Ulcer.—The early operations for duodenal ulcer involved minimal procedures about the pylorus. Pyloric obstruction was treated by pyloroplasty, first by Heineke (1886) and later by Mikulicz (1888) (Plate 32, *A* and *B*). Horsley in 1919 (Plate 32, *C*) and then Judd in 1922 (Plate 32, *D*) added the excision of an anterior wall ulcer to the pyloroplasty. A more extensive operation was devised by Finney (Plate 33). Gastroduodenostomy (Plate 38), introduced by Jaboulay (1892), and then gastroenterostomy (Plate 36) became the favorite operations for duodenal ulcers. Within the past two decades they have been replaced in nearly all instances by some type of gastric resection.

Besides the various types of gastric resection described above that are all applicable to ulcer, other procedures have evolved specifically for this disease. Resections for exclusion of the ulcer have been developed by Devine, whose procedure is exactly similar

Second a normal red cell count does not mean that preoperative transfusions are contraindicated Particularly in the presence of dehydration and weight loss blood often has to be given on an empiric basis Whenever possible the hemoglobin should be normal before operation Even in many apparently normal subjects preoperative administration of 500 cc blood followed by at least 500 cc more on the day of operation will be rewarded by a smoother convalescence

Finally depletion of certain specific electrolytes is corrected by the appropriate intravenous administration of these substances Reliance is placed chiefly on the use of 5 per cent glucose given either in distilled water or in saline solution depending on the serum chloride level *Potassium ion solutions are included if renal function is* normal Intravenous fluids must be given in sufficient quantity to produce an output of 1 000 cc urine daily Vitamin K may be required to produce a normal prothrombin time Other vitamin deficiencies are rare but vitamins C and B are often given before and after operation in combination with intravenous fluids

Every effort must be made to empty the colon of barium before any operation in the stomach or serious barium impactions may occur postoperatively Perforation of the sigmoid colon from these rock like masses has resulted in several instances when this detail was neglected

Certain other measures are indicated in specific cases If infection is apt to be encountered or if a cancer of the stomach is present, it is well to begin parenteral antibiotics 24 hours before operation For this purpose 300 000 units of penicillin and 0 25 Gm streptomycin are given intramuscularly every six hours In addition when operating for gastric cancer since so many carcinomas of the stomach involve the colon it is well to give special care to the preparation of the colon The administration of Sulfathalidine orally 8 Gm daily for five days or of neomycin 2 Gm four times daily for one day and adequate preoperative enemas are essential in such preparation

Special attention must often be paid to patients who have arteriosclerosis or poor cardiac function The routine administration of 0 12 Gm quinidine lactate three hours before operation is recommended in this group since it reduces the incidence of cardiac arrhythmia during operation

SECTION 3

Pre- and Postoperative Treatment, Anesthesia

Preoperative Preparation

Operations on the stomach and duodenum preferably are done on patients who are in a good state of nutrition and whose stomachs are empty and as free from edema or other inflammation as possible These objectives can be obtained in many cases when operation is done at a time of election with other operations carried out as emer gencies they can be achieved only partially

Preoperatively complete blood and urine examinations are made Various chemical determinations are carried out on the blood, in cluding those of serum protein chloride carbon dioxide–combining power nonprotein nitrogen and prothrombin time When there has been long continued pyloric obstruction serum sodium and potas sium levels will be of value The gastric residual is obtained and a gastric analysis done Other special studies such as secretory volume and cytologic smears of gastric sediment may be made X ray studies are carried out and gastroscopy is performed when indicated

The theory and methods of electrolyte and whole blood replace ment in the depleted patient are beyond the scope of this volume However several factors of importance should be mentioned In the first place abnormalities referable to long continued obstruction can not be corrected and the correction maintained except by surgical relief of the obstruction Complete unremitting obstruction should not be tolerated for more than a week before operation Minimal operative procedures such as jejunostomies for feeding have not been satisfactory in restoring normal blood chemistry

5 Ambulation Motions of the legs both passive and active are encouraged as soon as the patient has recovered from anesthesia Abdominal binders and tight bedclothes that restrict motion of the legs are avoided If the technic of operation has been satisfactory and there is no danger of hemorrhage or leakage from a suture line the patient takes a few steps the day after operation Periods of walking are gradually increased in length and frequency but use of a chair is not permitted for a week By this time the patient will be fully ambulatory without assistance Elastic stockings are applied regularly after operation and worn for two weeks unless contraindicated by poor arterial circulation of the legs

6 Enemas do little good and may be dangerous in the early postoperative period particularly if closure of the duodenum has been only moderately satisfactory If no bowel movement has occurred six or seven days after operation an enema may be given

7 Removal of sutures Since the nutrition of many of these patients is poor sutures must be left in place for correspondingly long periods Ordinarily skin sutures may be removed on the eleventh day and retention sutures on the fourteenth Although it is obvious that in nearly all instances sutures could be removed much earlier it is better to establish a later routine to avoid dehiscence

8 Removal of drains If a drain has been placed in the vicinity of a duodenal stump withdrawal is started on the seventh postoperative day and completed 24 hours later Jejunostomy tubes if inserted at the time of operation and not required for treatment of obstruction are removed on the eleventh postoperative day When stomal obstruction occurs the tubes are removed as soon as patency of the anastomosis is established Patency is most easily demonstrated under the fluoroscope with a barium swallow

9 Adjuvant measures The administration of vitamins B and C may be continued and E added Dicumarol may be given as prophylaxis against thromboembolism but should not be used if an ulcer has been excluded rather than excised because of the danger of hemorrhage

Fluid and Electrolyte Requirements

Fluid and electrolyte requirements are of special importance in many instances A brief discussion of the methods of replacement

Conduct of the Operation

A Levin tube always should be inserted before operation and the stomach emptied The tube is kept on suction throughout the procedure

During the operation the blood pressure and pulse must be kept as stable as possible This is accomplished most satisfactorily by inserting an intravenous needle before the operation is begun and administering normal saline solution or blood as indicated The blood loss during gastric resection usually is between 500 and 1 000 cc and this amount must be replaced

Following operation an additional 1 500 cc of 5 per cent dextrose in water is given intravenously to support the body requirements for the first 24 hour period

Postoperative Care

The principles outlined here must be modified in individual cases but in general terms the following course is planned

1 Oral intake The patient is given increasing amounts of food by mouth until a six meal bland diet is reached in nine days As a guide the diets listed in Appendix 2 may be followed

2 Intravenous fluids and electrolytes are given according to the schedule on page 32 Blood transfusions are not as a rule necessary after operation unless complications occur

3 Gastric drainage If the stomach has been decompressed at the time of operation by a catheter inserted through the jejunum or stomach the Levin tube may be withdrawn a few hours after operation when it is clear the catheter is working satisfactorily Otherwise, the Levin tube should be left in for 48 hours and aspirations should be performed once or twice every 24 hours if the patient becomes nauseated or vomits until the gastric residual is under 200 cc

4 Antibiotics no longer are given routinely because they apparently enhance the possibility of an acute pseudomembranous enteritis They are indicated if a perforation or local peritonitis has been found or pulmonary complications develop A combination of penicillin and streptomycin is usually given initially (300 000 units and 0 25 Gm respectively every three to six hours) and then changed as soon as cultures and sensitivity tests are available

intestinal drainage is not great but there is a constant loss in the urine of about 50–100 mEq daily if the kidneys are normal Chloride loss by vomiting will be variable and is particularly marked in patients with active obstructed ulcers in whom the free acid level is high

Operation is delayed if possible until the blood chemistry approaches normal However the surgeon should plan to spend not over a week in preparation since usually little can be accomplished after that time and the patient will soon need calories in the form of food Postoperatively electrolyte reserves will be low and sodium replacement in the form of D/S is necessary from the outset

2 The patient who, having exhausted his sodium and/or potassium reserve is treated postoperatively solely with D/W The onset as well as the cure of the resulting *low sodium syndrome* is dramatic Weakness apathy low blood pressure feeble pulse and signs of impending shock are instantly relieved by 5 per cent D/S Likewise it must be remembered that potassium reserves are minimal and can be exhausted in a few days by losses through the kidneys since there is no renal threshold for potassium as there is for sodium

3 The patient with stomal obstruction Here it is very easy to go wrong If the patient is kept on constant gastric suction and fluid losses are made up entirely by 5 per cent D/S the typical picture of hypokalemic hypochloremic alkalosis appears The abdomen finally becomes silent a persistent ileus appears the nonprotein nitrogen level rises and fever develops Stomal obstruction is perpetuated by edema that forms in all parts of the body following the saline flood This syndrome can be prevented by giving an adequate amount of potassium from the outset and by avoiding overadministration of sodium

The most important details of replacement therapy can be summarized as follows

1 Keep an accurate intake and output chart.

2 Adequate replacement of whole blood is essential

3 Have frequent accurate plasma level determinations of electrolytes

4 Replace all fluid losses by renal or insensible routes as 5 per cent D/W Extrarenal losses mav be made up as 5 per cent D/W

therapy in the usual cases encountered in gastric surgery will be considered in this section. It is obvious that electrolyte levels of the blood plasma must be followed by frequent accurate determinations and that careful intake and output charts be maintained. Use of an indwelling Foley catheter is the best way to check urinary output, particularly in the early postoperative period.

First, the patient will be considered who is in good condition and who has a gastric resection. On the day of operation he is given, by the intravenous route, 500 cc. of blood and 1,500 cc. of 5 per cent dextrose in water (D/W). If there is an unusual amount of sweating or the operating room is hot and the operation long, some additional dextrose in normal saline (D/S) will be required. The usual loss of salt by sweating is very low when the temperature of the operating room is under 75 F but increases rapidly above that level.

On the first postoperative day, assuming that urinary function is adequate, 3,000 cc. of 5 per cent D/W and 40 mEq. of potassium chloride are given. If there is very little loss by the Levin tube or any other type of intestinal drainage, the same schedule may be continued for three days. The intravenous fluids are gradually reduced and entirely omitted by the fourth or fifth postoperative day. Sodium need not be replaced before the fifth day unless sodium reserves have been low. On the other hand, potassium should be given regularly and must be replaced after the third day.

Metabolic abnormalities are found most often under these circumstances:

1. The patient enters with pyloric obstruction. Vomiting of several days' duration will have produced depletion of water and all electrolytes. Not only must replacement be carried out for urinary output, insensible loss, vomiting and Levin tube drainage but the backlog must be made up. This can best be done by estimating that a patient who is mildly dehydrated has lost 2 per cent of his body weight and that one who is badly dehydrated has lost 6 per cent. Replacement must be made with 5 per cent D/S and 5 per cent D/W, adding potassium as soon as an adequate urinary output has been established.

Roughly, it is possible to replace estimated loss by vomiting or Levin tube drainage by 5 per cent D/S, urine by D/W and insensible loss by D/W. The loss of potassium through gastric or upper

intestinal drainage is not great but there is a constant loss in the urine of about 50–100 mEq daily if the kidneys are normal Chloride loss by vomiting will be variable and is particularly marked in patients with active obstructed ulcers in whom the free acid level is high

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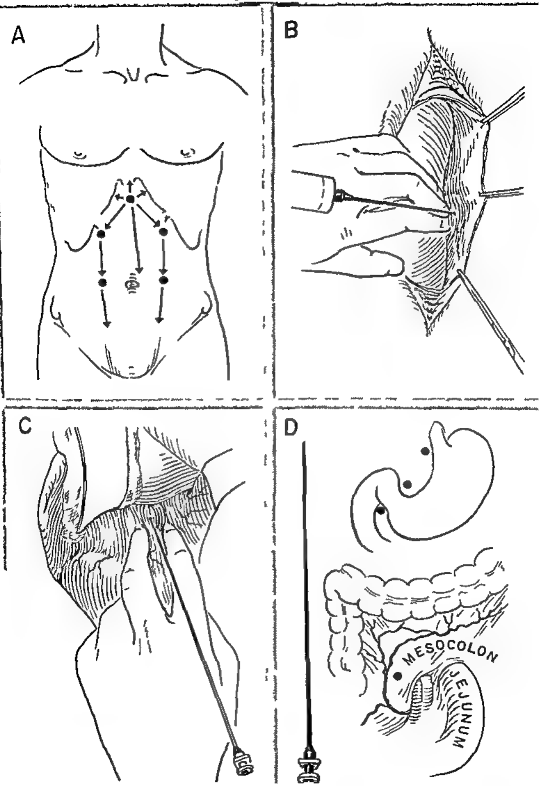
PLATE 4



for a few days, but after the fifth day they must be made up by 5 per cent D/S

5 Sodium must be given earlier to the postoperative patients who have a low sodium reserve or who have large extrarenal losses

6 Potassium is preferably given regularly postoperatively and must be given after the third day

Anesthesia

Although certain general rules can be stated for the type of anesthesia to be used obviously the method chosen must vary with the ability of the anesthetist Inhalation anesthesia or a combination of Pentothal and muscle relaxants are most popular today A general anesthetic with an intratracheal tube has many advantages particularly in the presence of obstruction or hemorrhage in open chest surgery or when a difficult technical problem may prolong operating time Spinal anesthesia secures excellent relaxation and therefore is preferred by many surgeons Generally it is best to restrict its use to operations done by well trained teams so that the operation can be finished before the anesthesia disappears Local anesthesia has been popular in the past and still can be used for some poor risk patients An adaptation of Finsterer's method modified by Ogilvie follows

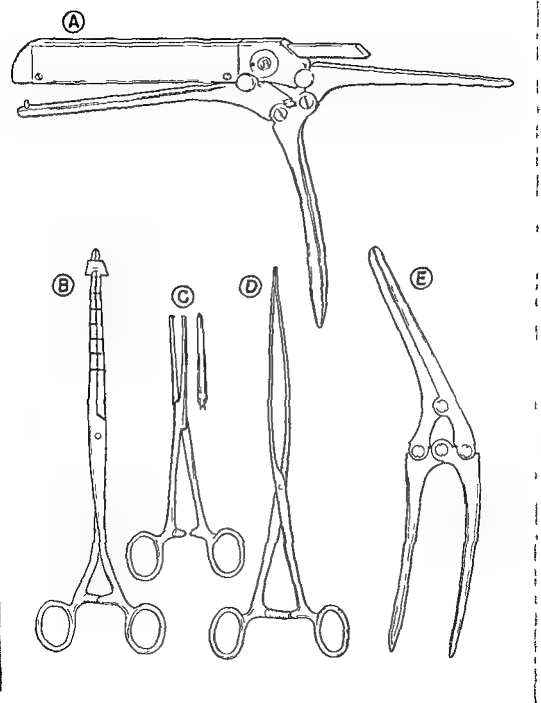
A —Five subcuticular wheals are made one below the xiphoid and two on either side just medial to the lateral margin of the rectus sheaths Through each wheal is injected 20 cc of a mixture of 0 5 per cent procaine and 0 25 per cent quinine and urea hydrochloride in saline with 1 drop epinephrine added for each 10 cc The line of incision is also infiltrated

B —After the peritoneum has been opened it is infiltrated on either side with 20 cc of the same solution

C —The liver is retracted upward and the stomach downward The left index finger pushes the aorta to the left and a Finsterer needle is inserted against the first lumbar vertebra Then 60 cc of a similar solution containing 1 per cent procaine instead of the 0 5 per cent strength is injected in this area

D —Further injection of 10 cc of the 0 5 per cent solution may be made (1) at the upper end of the lesser curvature (2) at the lower end of the lesser curvature (3) near termination of the gastroduodenal artery (4) near the origin of the superior mesenteric artery

PLATE 5



SECTION 4

Special Instruments

GASTRIC SURGERY is facilitated tremendously by the use of certain special instruments Many surgeons have designed clamps that embody desirable features which aid their special technics of resection or anastomosis Lack of space precludes detailed description of all these instruments, but brief mention will be made of those we have found most useful or that provide special features However, this does not mean that clamps are essential in gastric surgery since many able surgeons use them only rarely

A —The von Petz sewing clamp is an ingenious instrument that inserts two rows of metal clips automatically closing the stomach as the clamp is applied (Plate 79) However it is an expensive gadget that shortens the time of operation very little and enjoys limited popularity

B —The Wangensteen clamp is a delicate crushing clamp designed for an aseptic anastomosis A single clamp with ferrule is illustrated The method of application is shown in Plate 78

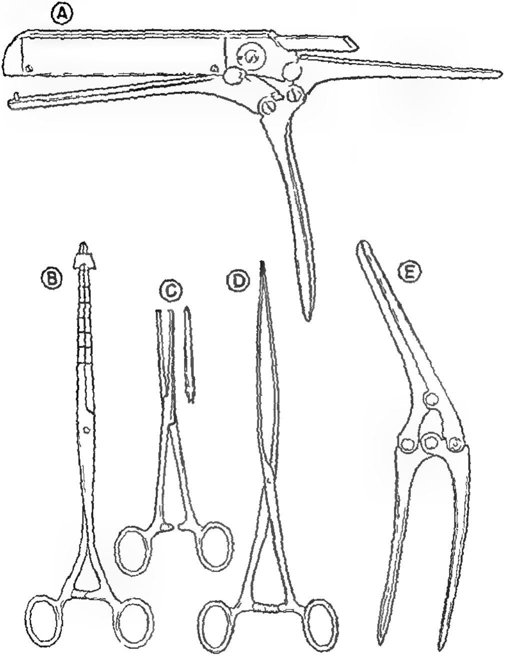
C —The Allen clamp is a modified Kocher hemostat with a long narrow blade It is relatively delicate and is therefore useful when the duodenum small intestine or colon is to be divided The clamp will hold the stomach wall but several clamps are required for division of the body of the stomach (Plate 59, Q)

D —Thin bladed steel clamps straight or curved, formerly were employed with intestinal anastomoses They may be used to prevent gross contamination in the unusual case in which stomach or intestine is poorly prepared

E —Payr clamps, in a variety of sizes are most valuable for gastric resection The relatively broad crushing surface holds the stomach firmly although this feature contributes to more trauma than can be tolerated by viscera other than the stomach

REFERENCES von Petz Payr Wangensteen

PLATE 5



SECTION 5

Incisions and Closure

THE TYPE OF INCISION used will depend on the underlying lesion the habitus of the patient the type of anesthesia available and the surgeon s preference It is most important that the abdominal surgeon recognize that he should not be limited by any particular type of approach whether it be through the abdomen or chest but that the incision should be the one best fitted for the particular patient In general, the duodenum is approached most easily by a right sided incision the body of the stomach by a left sided incision and lesions about the esophageal hiatus through a thoracic approach

When it is planned to restrict the incision to the abdomen a vertical incision is usually best but when the costal flare is wide a transverse incision will provide more adequate exposure To provide access to the upper stomach it is often advisable to curve the incision upward or occasionally to make a T incision with the short arm extending to the xiphoid

It will be found that if the patient is overweight exposure of the duodenum is often difficult through a left paramedian incision Consequently if undue difficulty is expected in this location such as an actively bleeding duodenal ulcer it is better to use a transverse or right sided approach

Midline vertical incisions are preferred by many surgeons but frequently one is cramped for exposure and special care must be taken with the closure However they are rapid and easy

Transthoracic incisions, so far as the scope of this volume is concerned are particularly valuable for the repair of hiatus hernia for cardioplasty, vagectomy and for the excision of tumors and ulcers of the cardia of the stomach When this incision is to be used an excel

lent anesthetist trained in thoracic surgery is absolutely essential

Abdominothoracic incisions are occasionally used when a carcinoma of doubtful operability is first explored through the abdomen and the operation completed after extension of the incision through the chest and wide division of the diaphragm The incision is well tolerated and undoubtedly will be employed more often in the future

Whatever the incision it must be fashioned in such a way that a strong closure can be made Patients with the type of lesions to be discussed are often malnourished depleted by lack of food and often by severe blood loss Healing tends to be poor and wound dehiscence is particularly apt to occur unless great care is taken The most important features in closure are (1) a minimum of trauma (2) absolute hemostasis (3) the use of nonabsorbable sutures in the fascia and subcutaneous tissues (4) the liberal use of stay sutures placed well back from the incision and maintained in position for at least two weeks in poor risk patients and (5) the support of the patient by proper diet blood transfusions and antibiotics during the post operative period When drainage is employed wicks or tubes should be brought out through stab wounds rather than through the main incision

Suture material.—Every surgeon has individual preferences as far as suture material is concerned Closure with catgut is the most rapid and is not subject to late discharge of sutures However wound disruptions or serum accumulations have been common enough to make the use of nonabsorbable sutures wise Fine cotton or silk sutures are well tolerated by the tissues but their tensile strength is not great they must be surprisingly strong to avoid rupture when the patient strains and particularly when the intratracheal tube is withdrawn Fine braided wire is much stronger and handles easily Unfortunately the body is less tolerant of it than of other materials The following method of closure is recommended continuous 0 chromic catgut on a nontraumatic needle for the peritoneum and 0 Surgaloy braided steel wire for through and through sutures while in the fascia #30 cotton #8 silk or 000 Surgaloy steel sutures may be used The author prefers cotton In thin patients the fascial sutures should be placed so that the knots will lie beneath the fascia This decreases the late formation of sinus tracts and the discharge of nonabsorbable material

Left Paramedian Incision

The left paramedian incision is the best single incision for operations on the stomach It can be extended to the xiphoid or well below the umbilicus to provide adequate space If a higher exposure is necessary extension across the costal margin may be obtained according to the technic demonstrated in Plate 12

A—The incision is particularly fitted for a patient with a narrow costal angle and a comparatively long distance from umbilicus to xiphoid A straight incision is made 2 cm to the left of the linea alba from the umbilicus nearly to the costal margin As soon as the skin incision is made skin towels are applied Subcutaneous vessels are caught with hemostats and ligated with fine cotton

B—The incision has been carried through the subcutaneous fat and rectus fascia Wide dissection of fat from the fascia is avoided The medial margin of the fascia is elevated between the tendinous inscriptions and the rectus muscle is dissected from the medial portion of the sheath and retracted laterally Perforating blood vessels are divided and ligated

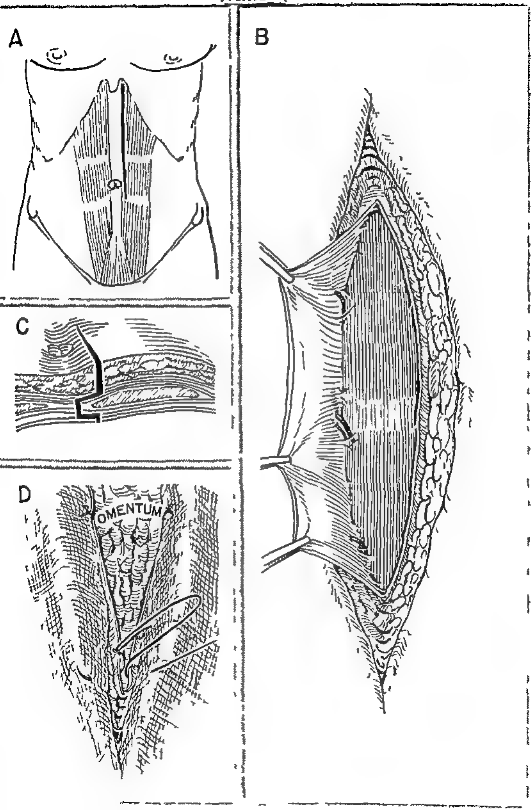
C—A cross section of the incision demonstrates the line of incision of posterior fascia and peritoneum below the retracted rectus

D—After the peritoneum has been opened the margins of the wound are protected by means of long sterile pads To prevent dislodgment during the operation these pads may be sutured in position at either end and midportion of the incision

The details of protection of wound margins will not be illustrated in many succeeding plates for the purpose of orientation and it must be assumed that this routine is used

[Closure of left paramedian incision on page 42]

PLATE 6



Left Paramedian Incision Closure

After completion of the operation the protecting gauze pads are removed from the margins of the wound It is best for the operating team to change gloves and to use clean instruments for the closure If the anesthetist is told that wound closure is imminent five minutes before the end of the operation a great deal of traction and trauma will be avoided A relatively deep plane of anesthesia is maintained until the skin sutures are being placed

A —The peritoneum is closed by a running 0 chromic catgut ligature on a nontraumatic needle

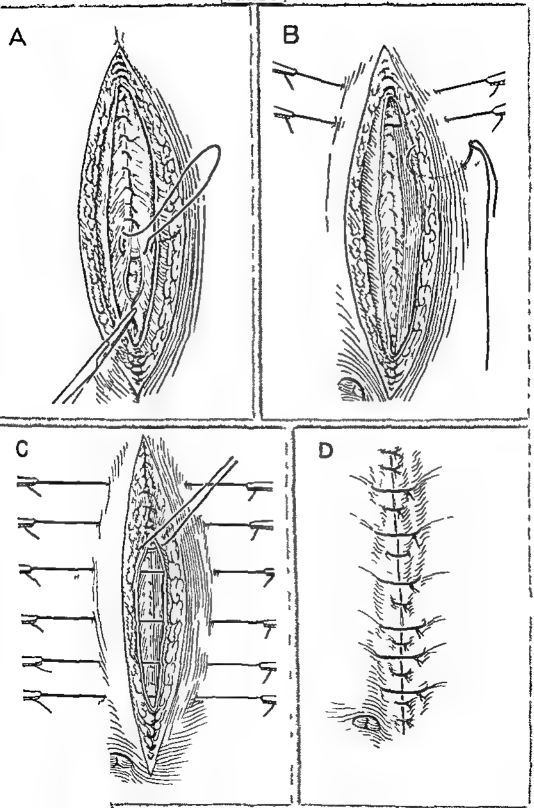
B —Skin towels have been removed Retention sutures are being placed They are of 0 Surgaloy braided steel wire #32 steel wire or #20 cotton Each suture is started about 2 cm from the skin margin and passes directly down through the anterior rectus fascia but not through the muscle It is then brought out in a corresponding position on the opposite side The sutures are placed at intervals of 2 cm so that six to eight are necessary

C —The anterior rectus fascia is closed with interrupted #30 cotton #8 silk or 000 Surgaloy braided wire sutures Each suture is placed 4-5 mm from the cut edge of fascia If finer bites are taken there is a tendency for the fascia to fray and the sutures pull out

D —After the fascial sutures have been tied the wound is irrigated thoroughly with saline solution and the skin is closed with interrupted silk The best skin coaptation is secured by vertical mattress sutures The retention sutures then are tied avoiding tension Finally a small dressing is secured in place with Elastoplast Abdominal binders are not used

The technic of closure of the abdominal wall by a single layer of stay sutures is advised by many surgeons Such a closure is recommended only in a straining distended patient in whom more meticulous closure is impossible

PLATE 7



Transverse Incision

A.—The transverse incision is indicated particularly for patients who have broad costal flares and a relatively short distance from xiphoid to umbilicus

B.—The incision has been made through the skin and subcutaneous fat The anterior rectus sheaths have been opened for a short distance across the midline The linea alba is then grasped with Kocher hemostats and elevated and the peritoneum opened just to the left of the midline

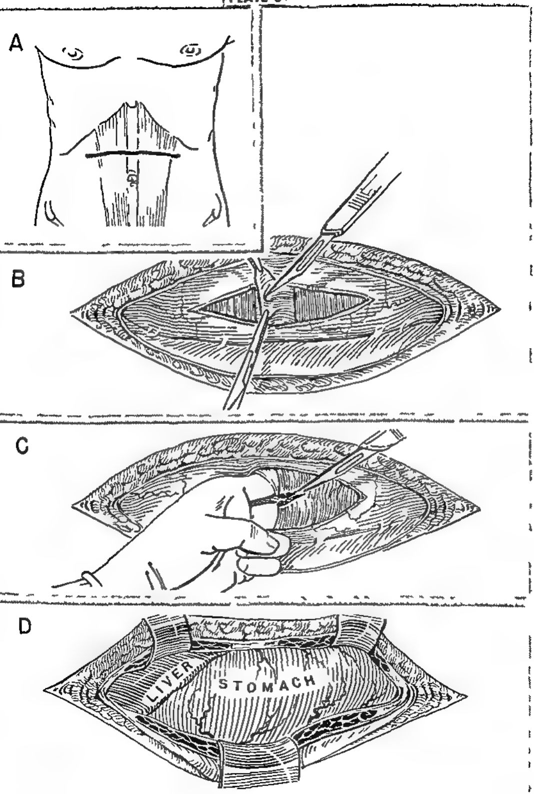
C.—The index and middle fingers of the left hand are inserted into the peritoneal cavity The abdominal wall can then be elevated and individual blood vessels identified and clamped as they are exposed Any bleeding is controlled easily by further elevation with the fingers After the left side has been opened the right half of the incision is made in a similar fashion Meanwhile the round ligament is divided and individual vessels ligated

D.—The incision has been completed Note that the exposure of the pylorus and duodenum is far superior to that obtained by a left paramedian incision The margins of the wound are protected by large gauze pads

Closure of the transverse incision involves (1) peritoneal suture with nontraumatic 0 chromic catgut (2) the insertion of retention sutures (3) closure of the anterior rectus sheath and oblique muscles with interrupted sutures and (4) silk sutures in the skin Particular care must be taken to obtain a strong closure about the linea alba which is the weakest part of the incision A strong posterior rectus sheath can also often be closed with a separate layer of sutures

Transverse incisions cut no more than one intercostal nerve are more comfortable than vertical incisions and result in finer scars However they are not so widely applicable because of the anatomical structure of most ulcer patients

PLATE 8



 Other Upper Abdominal Incisions

Other types of upper abdominal incisions are shown in Plate 9

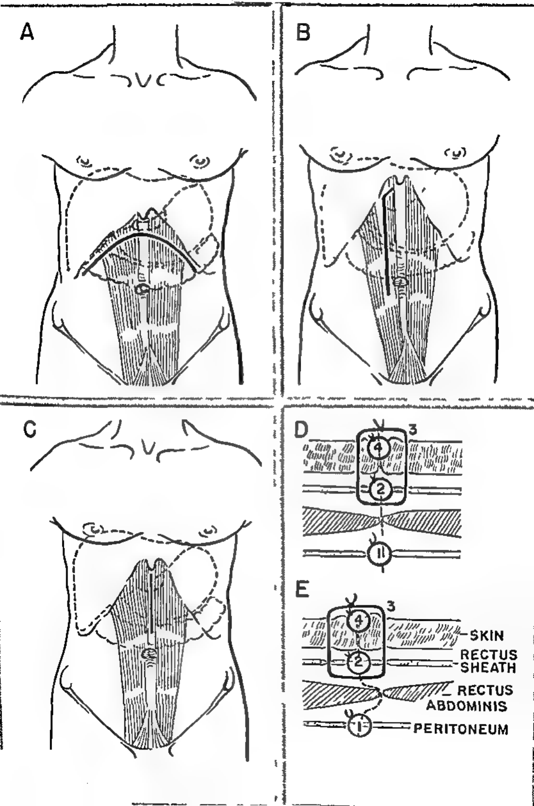
A—This *transverse incision* is curved upward in its midportion Excellent exposure of the duodenum and upper portion of the lesser curvature is obtained The incision lies about 1 in below the costal margin and xiphoid The method of making the incision and closure is similar to that used with the ordinary transverse wound

B—A *right paramedian incision* is particularly adapted to operations on the duodenum but high gastric resections are difficult through it It is the counterpart of the left paramedian incision illustrated in Plate 6

C—The *median incision* is often too short for adequate exposure but is excellent when the xiphoid is well away from the umbilicus It is carried directly through the linea alba Very few subcutaneous bleeders are encountered

D—Closure of the midline incision must be done with particular care as demonstrated in this cross section Both rectus sheaths are opened so that separate sutures in layers may be made of the peritoneum and the posterior rectus sheaths the rectus muscle the anterior rectus sheaths, and skin In addition retention sutures are placed through the anterior sheath at 2 cm intervals In this diagram the peritoneal and posterior rectus sheath suture is represented by 1 the anterior rectus sheath closure by 2 the retention sutures by 3 and the skin closure by suture 4

E—A cross section of closure of a paramedian incision shows the four layers of sutures 1 peritoneum and posterior rectus fascia 2 anterior rectus fascia 3 retention sutures 4 skin sutures


A
B
C
D
3
4
2
1
E
3
4
2
1
SKIN
RECTUS
SHEATH
RECTUS
ABDOMINIS
PERITONEUM

A.—The patient is placed on his right side A pillow is placed below the right leg and a second one between the knees A tilt table is best, but, if not available the left side of the patient is inclined backward about 30 degrees toward the surgeon The best exposure for operations near the esophageal hiatus or on the fundus of the stomach is secured by resection of the ninth rib Accordingly a long skin incision from near the costochondral junction to a point 4 cm lateral to the spinous process is made The incision is deepened through the subcutaneous fascia skin towels are applied and bleeding vessels ligated

B.—The ninth rib is exposed by incision through the latissimus dorsi and serratus anticus Closure of the posterior angle of the wound is facilitated if the layer of lumbodorsal fascia that covers the posterior portion of the rib is not cut

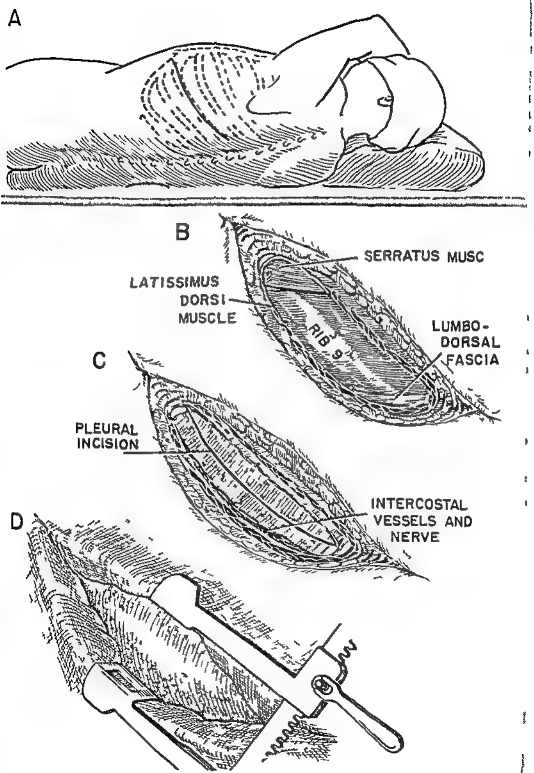
C.—The periosteum is stripped from the rib by periosteal elevators and as long a section as possible of the rib removed The type of rib elevators and shears used will depend on the personal preference of the surgeon If necessary the cut ends of the rib may be smoothed by a rongeur The incision through the pleura is made near the upper portion of the bed of the rib in order to avoid trauma to the intercostal vessels and nerve which run just inferior to each rib

D.—The pleural cavity has been opened and any underlying adhesions of the lung mobilized The wound edges are protected by gauze pads and the chest wall spread by a Finochietto retractor

It is not always necessary to resect a rib since an intercostal incision will provide an exposure that is more limited but perhaps adequate Excessive retraction through such an incision may result in fracture of several ribs so care is necessary to avoid too much trauma If this method is used the closure follows the details of Plate 13

[Closure of transthoracic incision *on page 50*]

PLATE 10


A
B
SERRATUS MUSC
LATISSIMUS
DORSI
MUSCLE
RIB 9
LUMBO-
DORSAL
FASCIA
C
PLEURAL
INCISION
INTERCOSTAL
VESSELS AND
NERVE
D

A —Drainage is instituted by means of a #24 Foley catheter inserted through a stab wound in the tenth intercostal space All sutures will be interrupted of silk or cotton The first row is placed in the pleura taking care to avoid the intercostal bundle The eighth and tenth ribs are then brought together by a Bailey approximator and thereafter the pleural sutures are tied

B —The intercostal muscles have been closed The serratus anticus and latissimus then are sutured in separate layers At this time the drainage catheter may be clamped and the anesthetist may stop the positive pressure that has been maintained throughout the operation

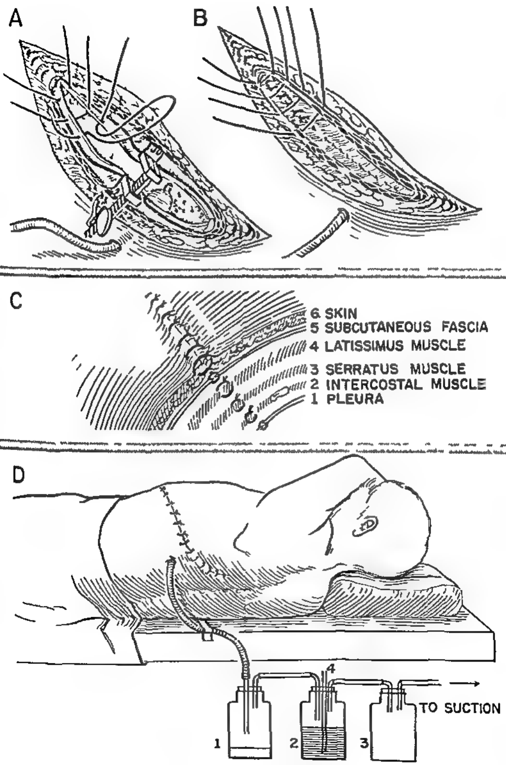
C —The cross section demonstrates the various layers employed in closure After suture of the latissimus fine nonabsorbable sutures are used to close the subcutaneous fascia Finally the skin is closed with silk

D —The drainage tube is placed on three bottle suction Drainage from the chest collects in bottle *1* Bottle *2* is partly filled with water The amount of suction is regulated by the open tube *4* the lower end of which is placed 8–10 cm below the water level The empty bottle *3* prevents liquid from escaping into the suction pump

Postoperatively the tube is maintained in position for 48 hours and then removed Although drainage is not essential it will prevent the occasional catastrophe that results from an undetected pneumothorax Removal of the blood from the pleural cavity also seems to produce a smoother convalescence Skin sutures are taken out on the ninth postoperative day

Severe intercostal neuritis is not uncommon after operation even when care has been taken to traumatize the nerve as little as possible The pain may lead to restricted respiratory movements and pulmonary atelectasis Intercostal procaine blocks repeated as necessary are the safest and easiest way to treat this complication

PLATE 11


A
B
C
6 SKIN
5 SUBCUTANEOUS FASCIA
4 LATISSIMUS MUSCLE
3 SERRATUS MUSCLE
2 INTERCOSTAL MUSCLE
1 PLEURA
D
4
TO SUCTION
1
2
3

[52] *Abdominothoracic Incisions*

Abdominothoracic incisions are of particular interest to the surgeon in exploration of carcinomas of the upper half of the stomach which are of doubtful operability The great advantage is the simplicity of abdominal exploration compared with exploration through a transthoracic incision and exposure through the diaphragm If the lesion is found to be inoperable the abdominal wall is closed if it is operable the incision is extended across the chest wall

A—The patient is placed on a tilt table with the body at an angle of 45 degrees to the table Support is gained by sandbags beneath shoulder and hip and appropriate restraining straps Pressure on the legs must be avoided by placing a pillow between them and a second one below the right leg

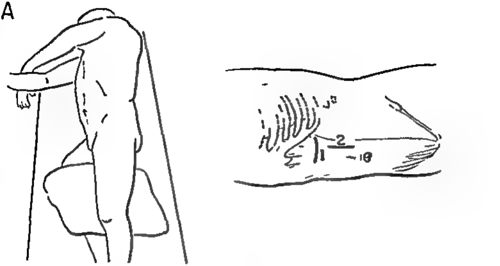
With the table tilted posteriorly the abdomen is opened through one of two incisions We prefer a transverse incision through the left rectus at a level of the ninth rib that can be extended directly back across the thorax if necessary (*1*) An alternative incision is a short left rectus splitting incision (*2*) Either incision is deepened through the peritoneum and the lesion palpated carefully If operable the incision is extended in such a manner that the stomach is exposed either by the abdominal or abdominothoracic routes The particular value of the transverse abdominal over the left rectus incision is that a better exposure of the duodenum can be gained

B—It has been elected to open the chest The skin incision has been extended along the eighth interspace as far posteriorly as the angle of the rib The approach will be facilitated by tilting the table forward at this stage

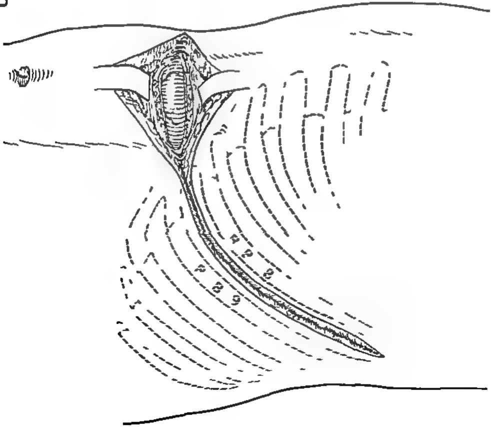
[Abdominothoracic incisions *continued on page 54*]

PLATE 12

A



B



C.—Skin towels have been applied. The incision is carried down through the latissimus dorsi and serratus anticus muscles. The eighth and ninth ribs and costal arch are exposed. The incision through the chest wall may be made either through the intercostal space or through the bed of the resected ninth rib. The latter method will give slightly more exposure but usually is not necessary with section of the costal cage. In this plate a rib is not resected.

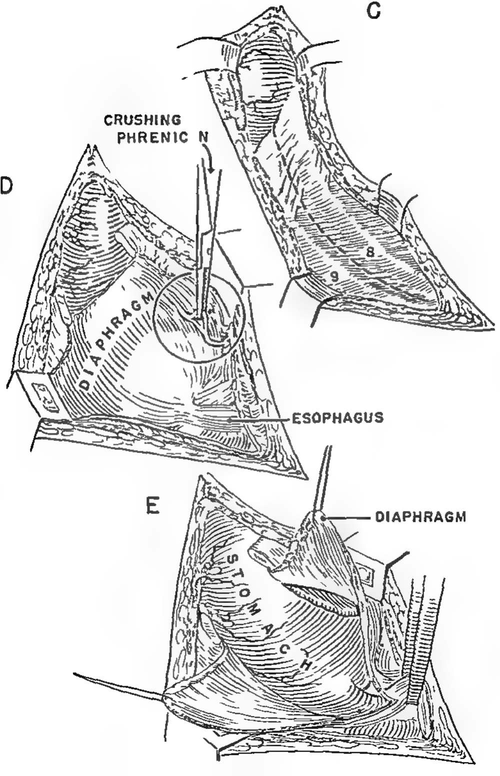
The intercostal muscles are divided along the dotted line. The pleura then is opened in the same line of incision. The lung is allowed to retract and the costal cartilages are exposed.

D.—The costal cage has been divided by the rib shears. The phrenic nerve is identified just above the diaphragm and crushed with a hemostat. Gauze packs are placed on the edges of the wound and the ribs are separated with a Finochietto retractor. The diaphragm is incised directly down to the esophageal hiatus. Several active arteries must be sutured in the diaphragm, including a large branch of the left inferior phrenic which runs just anterior to the hiatus.

E.—The diaphragm has been opened and is retracted by guy ligatures. Wide exposure of the stomach, spleen, esophagus and left lobe of the liver is obtained. If any difficulty is encountered about the duodenum, the incision can be extended easily across the opposite rectus. If for any reason higher exposure of the esophagus is required, two or three ribs may be divided posteriorly with the rib shears. The exposure obtained in this way is so satisfactory that the reader may wonder why it is not advocated in preference to other incisions. *The reasons are that the incision and closure are time consuming and, unless performed with care, there may be separation or sepsis at the costal margin.*

REFERENCES: Carter; Humphreys; Garlock.

[Closure of abdominothoracic incisions *on page 56*.]


C
D
CRUSHING
PHRENIC N
DIAPHRAGM
8
9
ESOPHAGUS
E
DIAPHRAGM
STOMACH

A—The abdominal portion of the incision is first closed in the usual manner and the diaphragm is closed with interrupted silk. A Foley catheter is next inserted through a stab wound in the tenth intercostal space to drain the pleural cavity, and the balloon is inflated. Thereafter the costal cage may be stabilized in one of two ways. If a rib has not been resected (as shown in the illustration) three heavy catgut sutures may be passed around the eighth and ninth ribs to be tied at a later stage. The second method, one that may be used in all cases and is necessary if a rib has been removed, is to suture the cut costal cartilage with one or two braided steel wires.

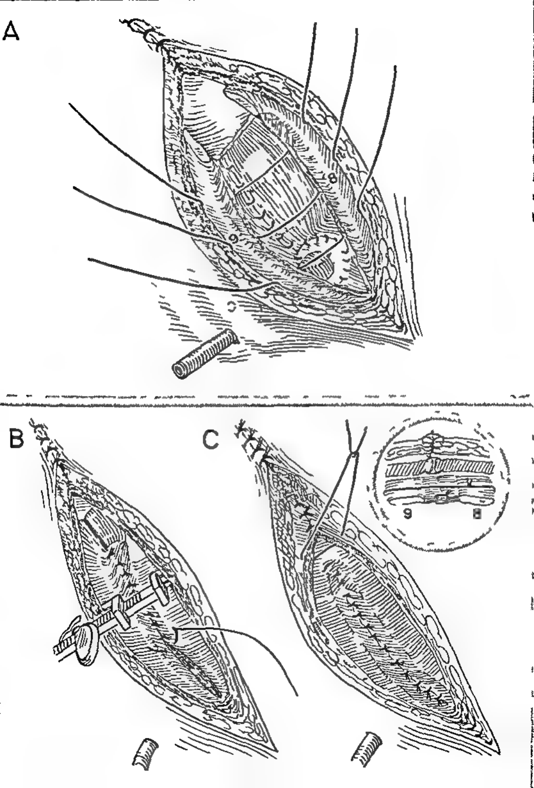
B—The lung is expanded completely, and the ribs are drawn together by a Bailey rib approximator. The intercostal muscles are then sutured with interrupted silk.

C—The chromic catgut sutures are tied. The serratus anticus and latissimus muscles are closed in separate layers. The subcutaneous fascia and skin are also closed in separate layers. The catheter is attached to suction as demonstrated in Plate 11.

The insert shows the various layers of the closed incision near the costal margin. It will be observed that there is little muscle protecting the ribs at this spot. For this reason, great care must be taken to secure a firm closure of the costal margin; any instability or sepsis in this area is troublesome.

It is important to note that the diaphragm must be closed securely whenever it is opened. Early postoperative dehiscence of this suture line may lead to herniation, incarceration or strangulation of any of the upper abdominal viscera. A two layer closure is preferable for this reason.

PLATE 13



SECTION 6

Congenital Abnormalities

CONGENITAL ABNORMALITIES of the stomach and duodenum include (1) hypertrophic pyloric stenosis (2) duodenal obstruction from periduodenal adhesions (3) duodenal obstruction from congenital diaphragms (4) duplications of either the stomach or duodenum and (5) duodenal obstruction from an annular pancreas Of these lesions the only common one is hypertrophic pyloric stenosis

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS —The typical history of projectile vomiting of undigested milk usually begins two to three weeks after birth in a male infant Peristaltic waves often can be observed running from left to right as the stomach contracts The pyloric tumor is nearly always palpable and the x ray picture is diagnostic The tumor is palpated most easily while the infant is taking a bottle or immediately after vomiting X rays taken after a swallow of thin barium will show a dilated stomach with a narrow elongated pylorus that permits the passage of only a small amount of barium

The infant should be operated on (Plate 14) as soon as the diagnosis is made and fluid balance has been restored Intravenous administration of 100 cc of 5 per cent glucose in saline twice daily is often necessary preoperatively A blood transfusion (20 cc/kg body weight) is required if malnutrition is severe A small Levin tube (#12) is passed into the stomach before operation

Postoperatively the formula is increased gradually Five per cent dextrose in saline is started in 30 cc amounts and given every two hours as soon as nausea has ceased By the end of a week the infant should tolerate 5 oz feedings of breast milk every three hours Intravenous fluids will be necessary at first if dehydration has been excessive

Periduodenal adhesions.—Obstructing periduodenal adhesions are most common with malrotation of the colon. Obstruction usually occurs at the lower angle of the duodenum. The vomitus contains bile and a scout x ray of the abdomen shows great dilatation of the stomach and first two portions of the duodenum. Laparotomy is carried out through a paramedian incision. The obstructing adhesions are cut. If there is a malrotation of the colon with the duodenum descending vertically on the right, the colon, after mobilization, is placed entirely in the left side of the abdomen (Ladd's operation).

Congenital diaphragms.—Congenital diaphragms may occur at any level in the duodenum. They may be partial or complete and often accompany atresia of other portions of the intestine. Consequently, if such a lesion is discovered at operation, the whole intestinal tract must be observed carefully. If the obstruction is low in the duodenum, it usually is possible to dilate the collapsed proximal jejunum by injection of saline solution into the lumen and to perform a one layer interrupted silk side to side duodenojejunostomy. Occasionally it may be possible to distend the distal duodenum in the same way, insert a knife through a duodenostomy incision made above the stricture and cut the membrane from within. However, *this operation usually is difficult and gives poor results; a duodenojejunostomy is a better procedure.*

Duplications.—Duplications of the stomach or duodenum are rare. They are usually manifested by the presence of large cysts near the head of the pancreas. Excision is apt to be a formidable procedure and should not be done unless it can be done easily without compromising the blood supply of the duodenum or biliary tree. Preferably, the duodenum should be opened and a cystenterostomy performed, thus allowing internal drainage of the cyst.

Annular pancreas.—In this situation, normal pancreas entirely surrounds the second portion of the duodenum and finally produces complete duodenal obstruction. Several operations have been used to relieve it. Division of the pancreatic ring, unless this is very small, may lead to reobstruction because of the formation of dense adhesions in the same spot and is dangerous if the ring is thick because a duct may be divided. Duodenojejunostomy above the ring has given good results, while postcolic gastroenterostomy or a gastric resection is a good alternative operation.

Hypertrophic Pyloric Stenosis

The only operation that now is employed for this lesion is pyloromyotomy It is of interest that before introduction of this operation gastroenterostomy had been used this was often successful but gastritis frequently developed requiring gastric resection at a later date

Pyloromyotomy

Various incisions have been used for pyloromyotomy Because infants with congenital hypertrophic pyloric stenosis are undernourished and are likely to strain and eviscerate, all incisions should be made high slightly above the lower margin of the right lobe of the liver so that additional protection will be afforded by this viscus For the same reason all incisions must be short, that is 4-5 cm in length

A—*The rectus splitting incision gives easy access to the peritoneal* cavity and can be extended rapidly if necessary It is however the incision most prone to dehiscence

B—A vertical incision that is carried through the anterior rectus sheath with the rectus muscle retracted medially to overlap the incision through the posterior sheath is very satisfactory since both excellent exposure and a strong closure are attained

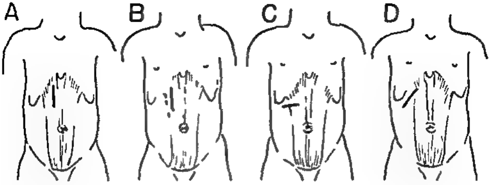
C—A transverse incision 2 cm below the costal margin through the outer portion of the rectus and the medial portion of the oblique muscles is preferred by many surgeons

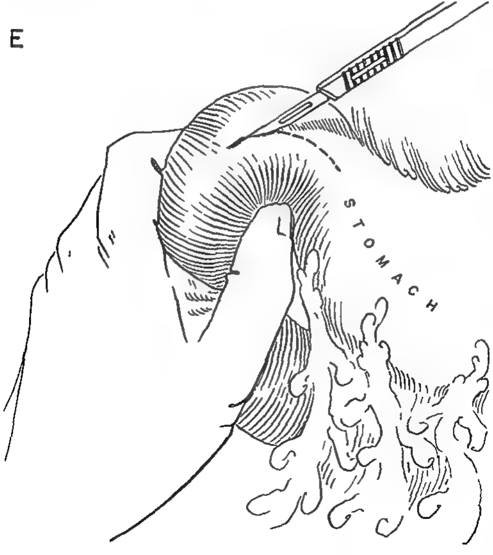
D—A gridiron incision has been advised by Robertson and has been adopted in the Boston Children s Hospital as the best approach in routine cases A 3 cm incision is made 1 cm below and parallel to the costal margin just lateral to the rectus sheath The external oblique is divided in the direction of its fibers then the internal in the line of its fibers and finally the transversalis fascia and peritoneum in a single layer

E—After the peritoneum is opened the stomach is identified and the pylorus and first portion of the duodenum withdrawn The surgeon then grasps the pyloric tumor firmly between the left thumb and index finger An incision is made with the scalpel through the anterosuperior surface of the pylorus along the avascular line The incision is deepened through the gritty muscle until mucosa is encountered

[Pyloromyotomy *continued on page 62*]

PLATE 14





Great care must be exercised on the duodenal margin of the incision where the muscular layer is thin

F.—With a fine hemostat the pyloric muscle is spread until the mucosa bulges widely into the incision Further extension of the incision may be necessary until it finally is about 2 cm in length

G.—A longitudinal section of the pylorus demonstrates the danger point at the upper duodenal angle where perforation is most likely to occur The cross section shows the pylorus after division of the muscle fibers

H.—Patency of the pylorus is now tested by grasping the duodenum in the left hand and the stomach in the right Pressure on the stomach should force gas easily through the pylorus Further muscular fibers may need to be divided This same maneuver tests the integrity of the duodenal mucosa If any bubbles of gas or fluid should escape there has been a perforation of the mucosa

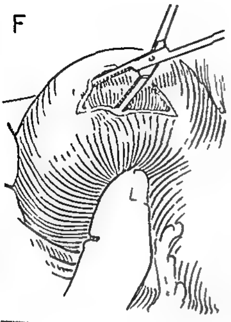
If perforation of the mucosa has occurred it should be closed by a fine catgut suture reinforced if possible by a wisp of omentum as depicted in this illustration In malnourished infants however no omentum may be present The Levin tube is kept on suction until the abdomen is soft and peristalsis active usually 48–72 hours At that time fluids are advanced cautiously

Complications.—The surgical postoperative complications include peritonitis due to unrecognized perforation of the mucosa persistent obstruction due to incomplete division of the muscle fibers, and wound complications such as sepsis dehiscence or hernia Intraperitoneal hemorrhage should never occur with careful technic Persistent obstruction must be recognized early and reoperation carried out the site of incomplete muscle division is usually found to be at the duodenal margin of the incision

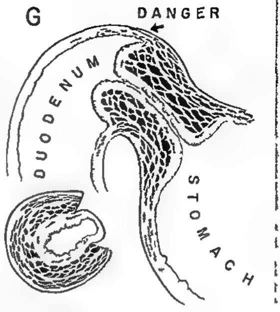
REFERENCES Rammstedt Robertson

PLATE 14

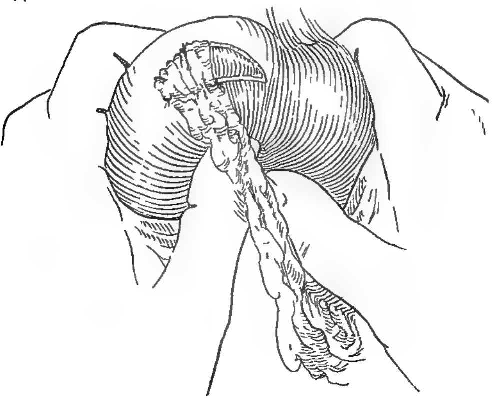
F



G



H



Other Congenital Abnormalities

Other congenital causes of duodenal obstruction are illustrated in these drawings Diagnosis is made on the basis of epigastric distention and the vomiting of clear fluid if the obstruction is above the ampulla or of bile if it is below Confirmation may be obtained by x rays either by a scout film or by peroral administration of a small amount of barium

I—Because of malrotation of the colon the cecum has become suspended in the right upper quadrant by dense adhesions which obstruct the lower angle of the duodenum

J—*Lysis of these adhesions relieves the obstruction* The duodenum now usually is found to lie to the right of the midline The colon has been placed in the left side of the abdomen by Ladd's maneuver where it now lies free and unsuspended Appendectomy is optional

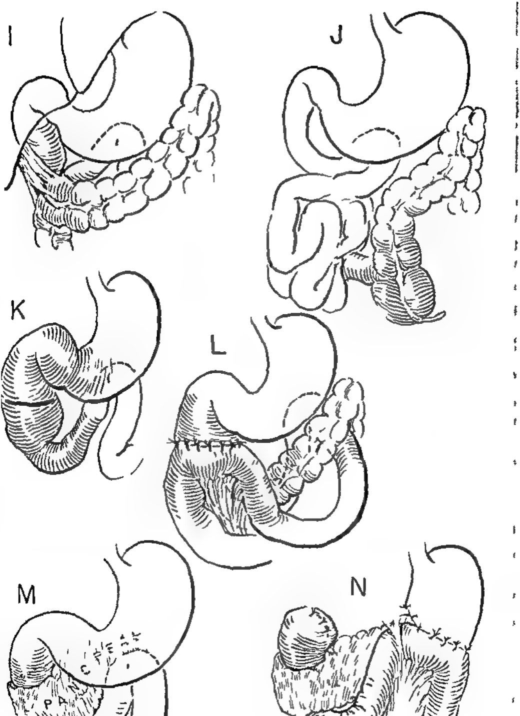
K—Obstruction in this instance is due to a stenosis just below the ampulla Diagnosis may be confirmed by transverse duodenotomy and insertion of an instrument within the lumen The duodenotomy is made at a spot that will be utilized for a duodenojejunostomy

L—A two layer antecolic duodenojejunostomy relieves the obstruction This has been found to be a more satisfactory procedure than division of the stenotic membrane or plastic procedures at the level of the stenosis

M—An annular pancreas usually produces duodenal obstruction in infancy though occasionally obstruction will not be manifested until adult life Division of the ring is not advised because of the danger of division of a duct and resultant pancreatitis Intrinsic obstruction of the duodenum due to a stenosis may be present as well in infants The most satisfactory procedure in infants is duodenojejunostomy as is shown in *L*

N—*In adults an annular pancreas is treated most satisfactorily* by a gastric resection with some type of gastrojejunostomy made at the option of the surgeon

PLATE 14



SECTION 7

Perforating Wounds

Repair of Wounds of the Stomach

The mortality is high following penetrating wounds of the stomach Laparotomy is indicated whenever a penetrating wound of the peritoneum is suspected and should be done as soon as the patient can be prepared for operation A Levin tube is passed preoperatively if the aspirate contains fresh blood a stomach wound may be suspected An x ray taken in the sitting position often shows free air beneath the diaphragm

A —Exposure of the entire stomach and particularly of the fundus and *posterior wall may be a major problem To secure an adequate inspection of the posterior wall it is necessary to divide the gastro* colic omentum and elevate the stomach Note that the inlying Levin tube is kept on constant suction throughout the operation since a distended stomach is difficult to inspect

B —The ragged devitalized edges of the wound are excised In the stomach there is much less danger of constriction of the lumen from debridement than there is in the small bowel so debridement may be fairly radical

C —The wound has been converted to a linear incision and the mucosa *has been closed after individual ligation of any large vessels* with a 00 chromic catgut suture A second layer of interrupted non absorbable sutures of the Lembert type is being placed Closure of a circular wound by a pursestring has been found to be inadequate it is better to make a linear suture routinely

D —The outer layer of sutures has been tied Reinforcement with an omental tag may be used if desired

PLATE 15

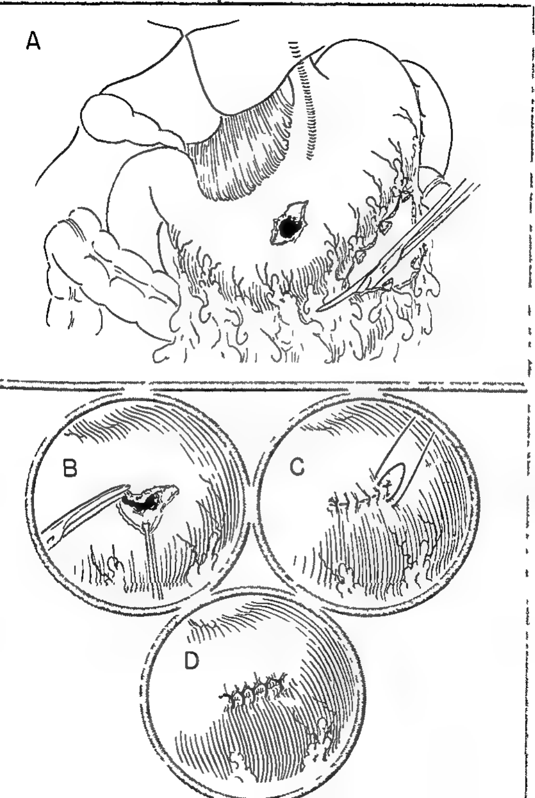


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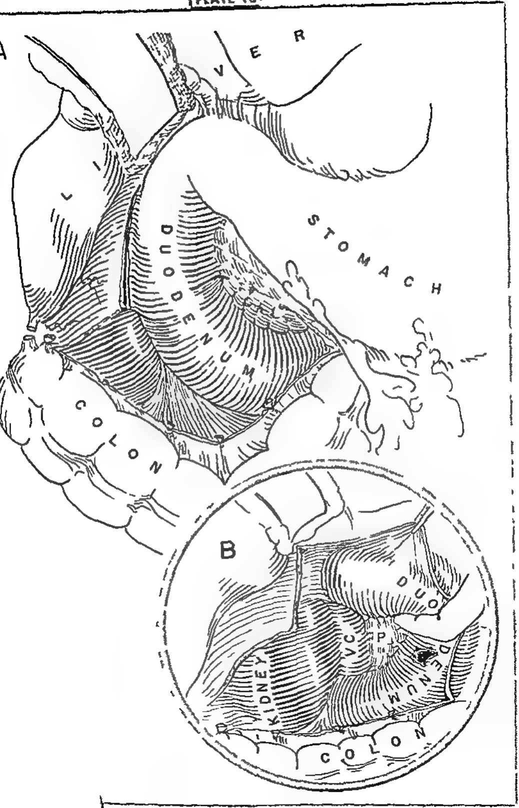
PLATE 16



Wounds of the Duodenum

Wounds of the duodenum are hard to diagnose and repair, chiefly because of the difficulty of anatomical exposure At laparotomy, the presence of retroperitoneal edema or bile extravasation about the duodenum will indicate the necessity of exposure of the retroperitoneal portion of this organ

In general wounds may be treated in two ways Small perforations may be sutured (Plate 16 *E*) Large wounds with considerable destruction require a sleeve resection (Plate 17), with end to end anastomosis either of the cut ends of the duodenum or of the duodenum and jejunum The common duct should be identified if the region of the ampulla has been involved, since the duct may have to be reimplanted After any wound in this area particularly because of concomitant damage to the pancreas it is wise to institute drainage

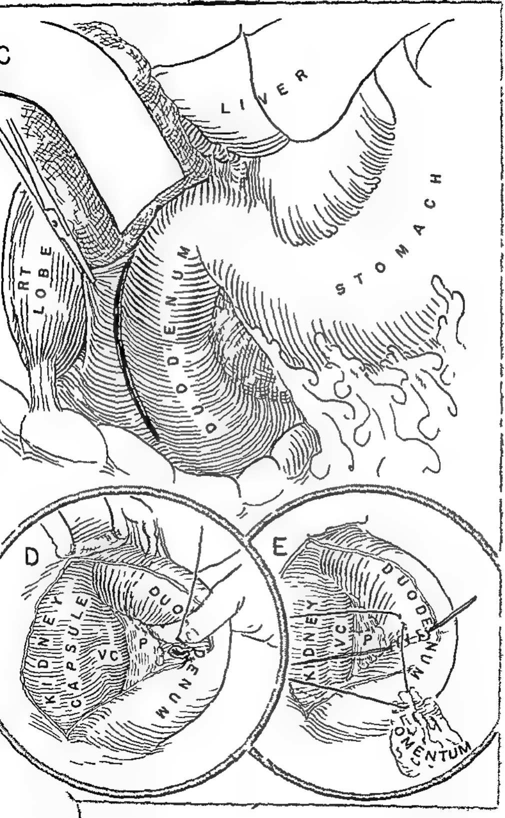
Exposure of the Duodenum

A—The best exposure of the duodenum is gained by wide mobilization of the hepatic flexure of the colon The hepatic flexure is freed by division of the suspensory bands that run from the lateral abdominal wall and the lower portion of the right lobe of the liver These ligaments are vascular and must be ligated The right portion of the gastrocolic omentum may need to be divided

B—The avascular lateral peritoneum is then divided as it is reflected over the lateral margin of the ascending colon The ascending colon and hepatic flexure together with the mesentery of the colon are reflected forward downward and to the left exposing the entire duodenum as far medially as the superior mesenteric vessels The upper part of the second portion of the duodenum can be mobilized even further by division of the posterior parietal peritoneum just lateral to the duodenum The small terminal portion of the duodenum that lies beyond the superior mesenteric vessels requires careful dissection about the ligament of Treitz to avoid injury to the middle colic artery

[Exposure of the duodenum *continued on page 70*]

PLATE 16


C
LIVER
STOMACH
RT LOBE
DUODENUM
D
KIDNEY
CAPSULE
VC
P
DUODENUM
E
KIDNEY
VC
P
DUODENUM
OMENTUM

Wounds of the Duodenum

Often it is not necessary to visualize the lower angle of the duodenum and for most operations in the region of the ampulla a simpler method of exposure will suffice

C—A Deaver retractor pulls the right lobe of the liver upward while the transverse colon is held down by a gauze pack With most of the second portion of the duodenum visible the peritoneum just lateral to the duodenum is divided The dissection normally is avascular however if large veins have been produced by disease they should be ligated since rather serious bleeding may occur

D—With gentle dissection the duodenum is now elevated and rolled medially exposing in turn the capsule of the right kidney the renal vessels the vena cava and the head of the pancreas

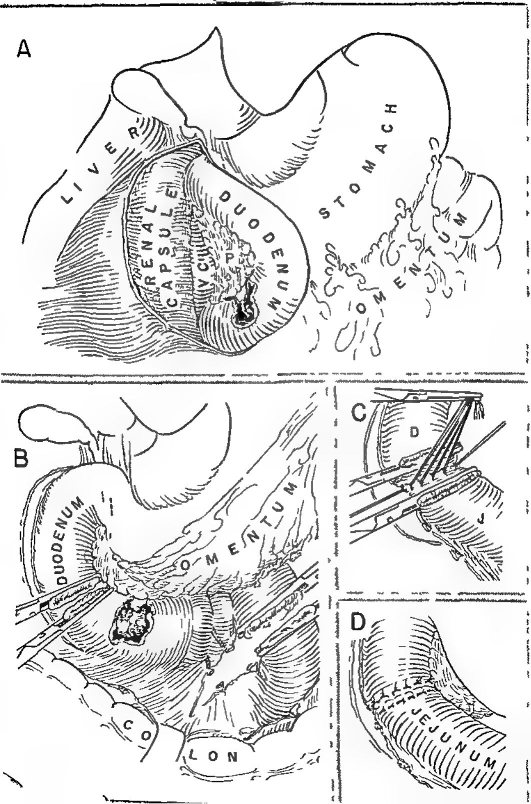
Repair of Wounds

The method of closure of a wound of the retroperitoneal duodenum is shown Closure is first effected by a layer of running 000 catgut on a nontraumatic needle If possible a transverse rather than a longitudinal closure should be made since the lumen will not be constricted thereby

E—A second layer of interrupted nonabsorbable sutures of the Lembert type has been placed Occasionally it is possible to insert a third layer of sutures but this should be done with care Reinforcement with a tag of omentum is usually wise The duodenum is then allowed to fall back into its normal position Finally a cigaret wick is placed in Morison s pouch avoiding contact with the suture line The wick is brought out through a stab wound in the flank It is often advisable at this time to perform a catheter jejunostomy for feeding so that the duodenum may be kept at rest for several days Postoperatively a Levin tube should be left in the stomach for five days

[Repair of wounds *continued on page* 72]

PLATE 17



A
LIVER
RENAL CAPSULE
VC
P
DUODENUM
STOMACH
OMENTUM
OMENTUM
B
DUODENUM
OMENTUM
COLON
C
D
J
D
JEJUNUM

[72] *Sleeve Resection of Duodenum*

For extensive wounds of the duodenum a resection of the involved portion with an end to end anastomosis must be done The same technic is available for the excision of certain tumors of the duodenum

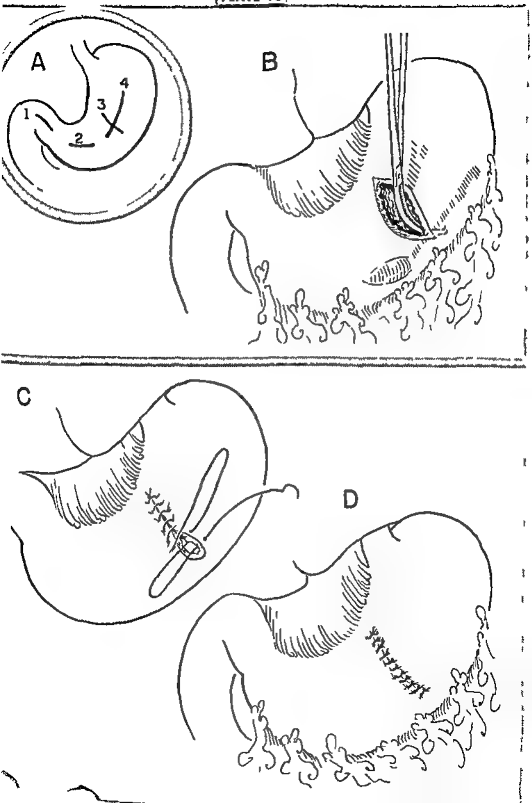
A—A severe wound of the inferior angle of the duodenum is exposed by mobilization of the hepatic flexure and division of the peritoneum lateral to the duodenum (Plate 16)

B—The location of the papilla of Vater is cephalad to the line of division of the duodenum The duodenum is divided between thin bladed Kocher clamps with the scalpel The jejunum is then divided between a similar pair of clamps the points of the clamps being directed toward the mesentery If the jejunal mesentery is short more mobility may be obtained by dividing the jejunum at a lower level Individual vessels supplying the segment of bowel to be removed are caught with hemostats divided and ligated The distal duodenum is pushed behind the superior mesenteric vessels toward the patient s right side meanwhile the small blood vessels that arise from them are divided Great care must be taken to avoid trauma to the superior mesenteric vessels The distal duodenum and proximal jejunum are then excised

C—The jejunum has been brought through the mesocolon in a position that will avoid kinking A two layer end to end anastomosis is then made The outer posterior row of interrupted cotton sutures has just been inserted uniting jejunum *J* and duodenum *D* This is followed by an inner layer of 000 catgut

D—The anastomosis has been completed by an outer anterior layer of interrupted cotton sutures The jejunum should be sutured to the mesocolon about the margins of the new opening to prevent herniation of another loop of jejunum

PLATE 18



SECTION 8

Gastrotomy and Duodenotomy

Gastrotomy

GASTROTOMY IS PERFORMED for many reasons particularly for removal of foreign bodies demonstration of bleeding points excision of hyper trophic pyloric mucosa local excision of a polyp and inspection of the mucous membrane when carcinoma is suspected

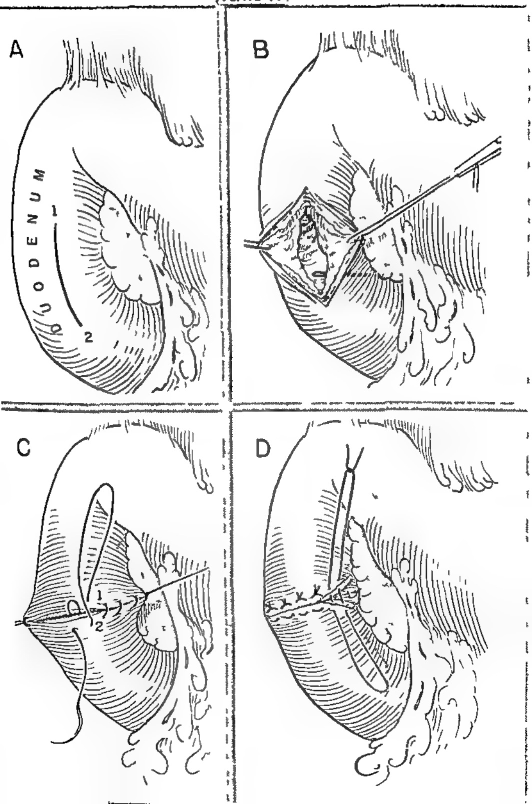
A —The location of typical incisions is shown Because the stom ach is large almost any incision can be closed without danger of constriction of the lumen However it is a good rule to make the incision near the suspected area of pathology and therefore as short as possible Incision *1* is indicated in certain cases of hemorrhage and may be extended across the pylorus if necessary If this incision is not followed by resection it should be closed by the Heineke Mikulicz method to avoid pyloric obstruction Incisions *2* *3* and *4* will dem onstrate other areas of the gastric mucosa

B —The stomach has been opened and a teaspoon is being ex tracted Observation of the interior of the stomach may be aided by inserting two Richardson retractors and elevating the anterior wall

C —The incision is closed in two layers Here an inner layer of 00 catgut is being placed by the Connell method

D —Closure has been completed by an outer row of interrupted cotton sutures

When gastrotomy is to be performed for a foreign body several features should be emphasized (1) If the object is opaque x rays should be taken just before operation to assure accurate localization (2) If one foreign body is present careful search must be made for others (3) Care must be taken to avoid contamination of the peri toneal cavity or excessive trauma to the gastric wall


A
B
C
D
DUODENUM
1
2
1
2

 Duodenotomy

Duodenotomy is used most commonly in conjunction with exploration of the common duct to demonstrate the ampulla of Vater with accuracy In addition it is required for the demonstration of foreign bodies for the excision of polyps and occasionally for the discovery of the source of hemorrhage

A—The duodenum is opened through a vertical incision that should be directly over the lesion and as short as possible Narrow thin bladed retractors may be inserted which, on elevation will improve the view of the posterior wall

B—Stay sutures are inserted on either margin of the incision mid way from either end In the illustration the duodenotomy has demonstrated a needle which is extracted

C—Tension on the stay sutures then transforms the vertical into a horizontal incision The mucosa is closed with a running Connell suture of 000 catgut on a nontraumatic needle

D—Closure is completed by the insertion of an outer layer of interrupted cotton or silk Note that the diameter of the duodenum has been increased by this closure rather than diminished as it would be if the closure were made in a longitudinal direction

Closure of a duodenotomy incision also may be done safely in a vertical direction Such a method is necessary whenever the incision is long However care must be taken to prevent occlusion of the lumen which may result from postoperative edema if too wide a diaphragm is turned in

Postoperatively in common with other operations on the duodenum it is necessary that a Levin tube be used for several days to maintain an empty stomach until the integrity of the suture is established

patient is a good risk local procaine infiltration supplemented by Pentothal if necessary is best when the patient is in poor condition

Postoperative care —The main postoperative problem is to avoid *trauma to the stoma until the gastric tube is firmly healed and the* stomach securely attached to the abdominal wall If Witzel or Stamm gastrostomies are made great care must be taken to anchor the catheter firmly for 10–14 days are required for healing that is sufficient to secure safe replacement if the catheter is accidentally withdrawn With permanent gastrostomies, healing of the tube takes at least a week During this period the introduction of catheters or syringes may rupture the suture line with fatal results Consequently *it is safer to use intravenous alimentation for several days* and the patient should not be allowed to introduce anything into the stomach until he has had a period of careful training

Complications —The hospital mortality following gastrostomy for inoperable cancer is very high chiefly because of the complications attendant on the primary disease Peritonitis is not uncommon, since these patients heal poorly It usually originates from leakage between the stomach and the anterior abdominal wall particularly with the catheter types of gastrostomy Wound dehiscence also occurs frequently since many of these patients have severe coughing spells Bronchopneumonia *is common* and nearly always fatal

Postoperative diet —By far the best food that can be used postoperatively is prepared by passing a normal day s diet through the Waring blendor as shown by Fallis and Barron In this fashion a liquid is produced that can be introduced through even very small catheters Diarrhea is extremely common with most other mixtures although the stomach will accept high caloric combinations more satisfactorily than the jejunum Homogenized milk is usually well tolerated

Postoperative decompression of the stomach —If after any type of abdominal surgery long continued Levin tube decompression of the gastrointestinal tract probably will be necessary some method of catheter drainage of the stomach should be considered instead If the stomach is intact the insertion of a Foley catheter by the technic advised by Farris and Smith is effective (Plate 20 *E*) If a high gastric resection has been done the method of Allen and Donaldson (Plate 70) may be employed

SECTION 9

Gastrostomy

GASTROSTOMY FORMERLY WAS a very common operation Now that many esophageal lesions are treated definitively by surgery it has become less popular There are however, several indications for its use It is indicated particularly in these situations

1 When inoperable malignant disease of the esophagus or pharynx is present, or when esophageal obstruction has occurred from tumors of adjacent organs such as the larynx It must be noted that in many of these patients life is extended so slightly by gastrostomy that the operation is a useless gesture

2 For multiple benign strictures of the esophagus when a protracted series of dilatations is advised

3 As a preliminary procedure in certain operations on the esophagus for example, in malnourished patients with megaesophagus from achalasia

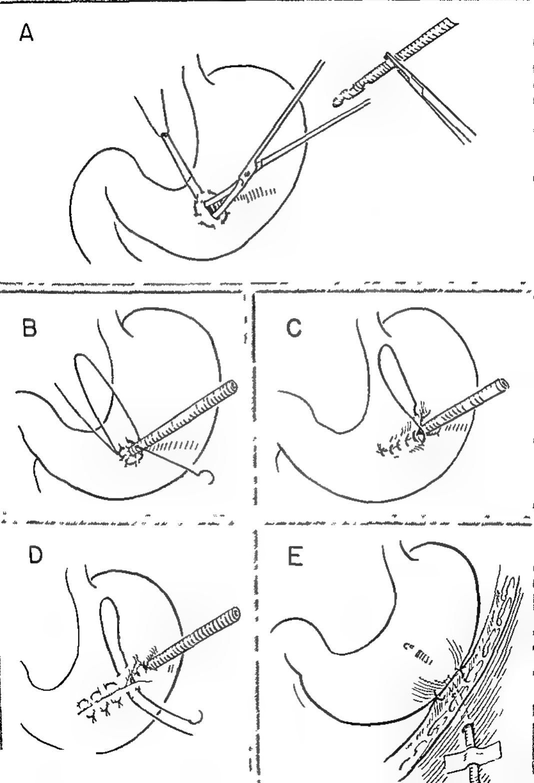
4 As a method of decompression of the postoperative stomach

For the first indication when life expectancy is three months or more or for the second indication the gastrostomy should be of the "permanent" type (Beck Jianu Spivack or Janeway) in other cases a "temporary" gastrostomy (Witzel Stamm Kader) may be performed Under all circumstances in which further surgery requiring the transplantation of the stomach into the chest may be done the stomach should be mutilated as little as possible by a gastrostomy in order that its full length may be available later In such cases a jejunostomy may be preferable

Preoperative preparation —The esophagus should be emptied as completely as possible with a Levin tube

Anesthesia —Whereas general anesthesia may be used when the

PLATE 20



The simplest gastrostomies are those made with catheters His torically Witzel's method takes precedence Large tubes may be used in this fashion (Plate 20 *A–D*) or by the Stamm or Kader methods (Plate 21) The Foley catheter now provides an even easier technic (Plate 20 *E*)

WITZEL GASTROSTOMY —*A*—The abdomen has been opened through a short left upper rectus splitting incision The catheter may be inserted either with the tip directed toward the pylorus or toward the fundus depending on the manner in which it will lie most com fortably A pursestring or 00 chromic catgut is inserted and the stomach opened within it by the scissors

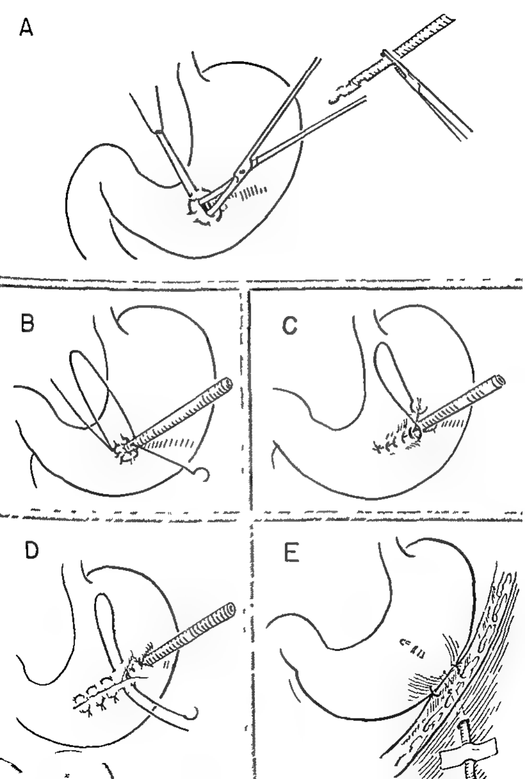
B—A #26 catheter has been prepared by cutting several extra holes in the tip and has been inserted The pursestring suture has been tied and the catheter is now caught with the same suture and tied in position

C—A running suture of 00 chromic catgut is now used to form a tunnel enclosing the catheter This suture is begun just beyond the previous pursestring and catches the serosa on either side of the catheter The tunnel is made about 2 in long

D—A second layer of interrupted sutures is inserted infolding the previous layer

FOLEY CATHETER GASTROSTOMY —*E*—For a temporary postopera tive gastrostomy the adaptation of the Foley catheter technic as described by Farris and Smith is recommended A catheter with a 30 cc inflatable balloon is tested before use to be certain the cathe ter and balloon function perfectly Through a short incision the catheter is inserted into the anterior wall of the stomach and the balloon inflated The catheter then is anchored by one suture This is snugged up not too tightly to allow later deflation of the balloon The catheter is brought out through a stab wound and by traction the stomach is drawn up to the abdominal wall One or two addi tional sutures may be placed to hold it here if desired

REFERENCES Witzel Farris and Smith


A
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D
E

 Stamm Kader Gastrostomy

The Stamm and Kader methods of gastrostomy differ from the Witzel type only in the manner in which the tube is introduced into the stomach In the Stamm operation the tube is held in the stomach by a series of pursestring sutures whereas in the Kader type several layers of Lembert sutures pleat the gastric wall about the catheter In either case the tube is brought out at right angles to the long axis of the stomach rather than parallel to it as in the Witzel type The Stamm gastrostomy will be shown in this plate

A—The abdomen is opened under local anesthesia with a high short, left rectus splitting incision This operation is particularly applicable when the stomach is small and contracted With care to prevent contamination the anterior wall of the stomach near the midportion is delivered through the abdominal wall and a purse string suture made The stomach is opened and a #26 catheter inserted The suture is tied and the catheter is then caught with the same needle and tied in place

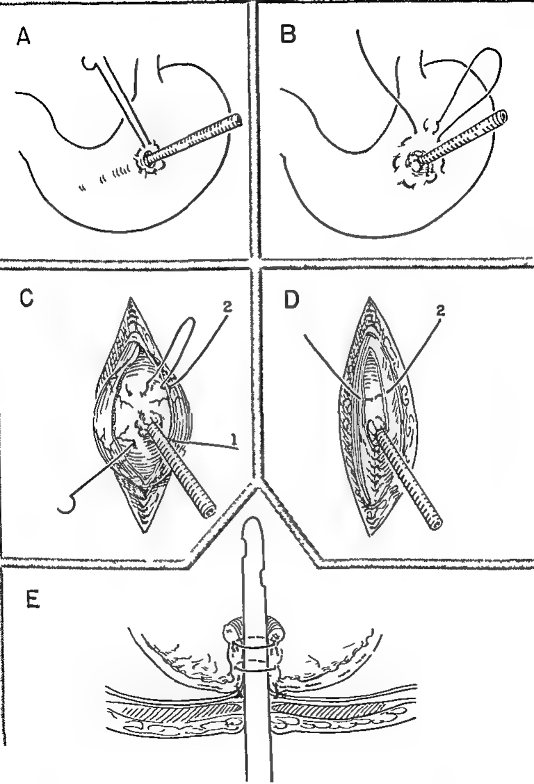
B—A second inverting pursestring suture is now inserted about 1 5 cm outside the first It is tied effectively sealing the opening in the stomach If the stomach is of sufficient size a third pursestring may be used

C—It is important with any tube gastrostomy to suture the stomach tightly to the abdominal wall so that the serosa becomes intimately adherent to the peritoneum For this purpose two sutures (*1* and *2*) are passed above and below the tube catching both peritoneal margins and the gastric wall

D—Sutures *1* and *2* are tied and the abdominal wall closed about the catheter

E—A cross section of the tube in place shows the enfolded stomach

REFERENCES Stamm Kader

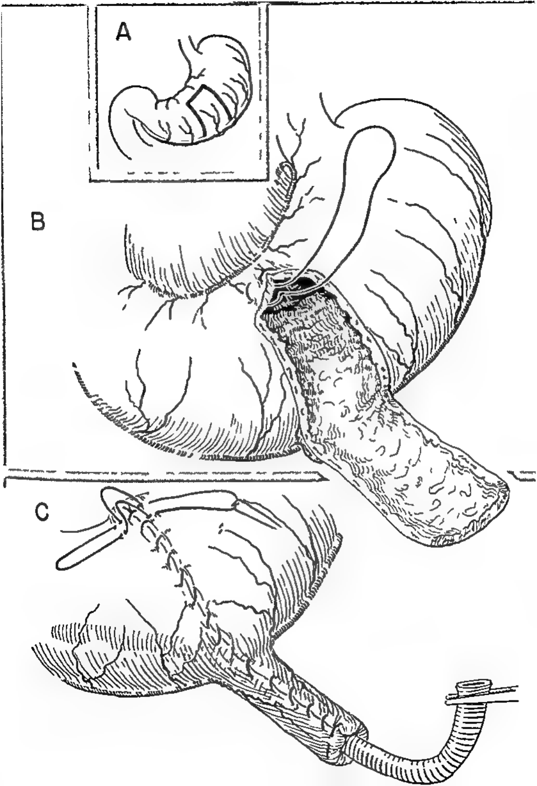

A
B
C
2
1
D
2
E

A.—Local anesthesia is satisfactory if the condition of the patient is poor. The abdomen is opened through a short left, upper rectus splitting incision. The abdominal wall is protected by sterile pads to eliminate any spillage. A flap is outlined on the anterior wall of the stomach just above the midportion. It extends from near the lesser curvature to the greater curvature and should be about 2 in. in width. It should be rectangular in shape, with the base at the greater curvature slightly wider than at the tip. It must not be more than twice as long as it is wide. It is important that the vessels along the greater curvature be handled with care to avoid trauma and loss of nutrition to the flap. The stomach is controlled by four Allis forceps placed at the angles of the flap, and the incision is continued through the wall of the stomach. Individual blood vessels are ligated.

B.—A running catgut suture now is begun at the midportion of the horizontal incision near the lesser curvature and is continued as a Connell suture, converting the rectangular defect to a linear suture. A catheter approximately ½ in. in diameter is then laid along the open tube, and the suture is continued all the way along the flap. Care is taken to avoid taking large bites, especially along the newly constructed tube.

C.—The inner suture has been completed and tied. A second layer of Halsted sutures of cotton or silk is now laid to invert the previous row. These sutures also are started near the lesser curvature and carried down to the tip of the tube.

[Janeway gastrostomy *continued on page 86*.]


A
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D—The outer layer of sutures has been completed The catheter should fit snugly but the tube should not be closed too tightly about it The catheter may be held in place by a catgut suture passed through the end of the tube The catheter is clamped to avoid any leakage as the wound is closed

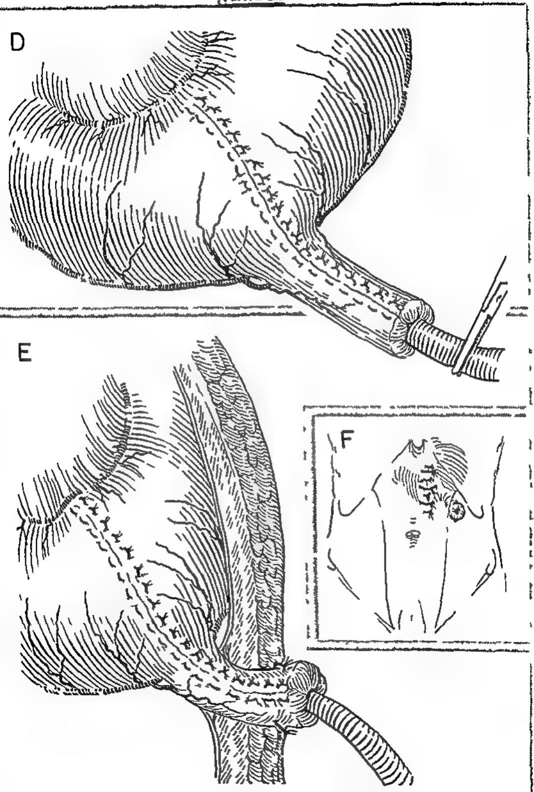
E—*The relation of the gastric tube to the skin is shown in this* cross section The tube is to be withdrawn about 1 cm beyond the skin edge It may be brought out either through the abdominal incision or through a stab wound If the tube is placed in the incision it is best to bring it out at the upper end, since less leakage tends to occur when the stoma is high The tube is then sutured to the skin by three or four fine silk sutures that penetrate only into the muscular coat

F—In this instance the tube has been brought through a stab wound The incision can now be closed more firmly than if the tube emerges through it The stoma is placed near the costal margin and as high as possible avoiding kinking of the tube In most instances it can be placed higher than shown in this figure

Although the Janeway gastrostomy is the simplest of the permanent types it is more likely to leak than are the Spivack or Beck Jianu types On the other hand the danger of complications from technical errors is correspondingly reduced

REFERENCE Janeway

PLATE 22



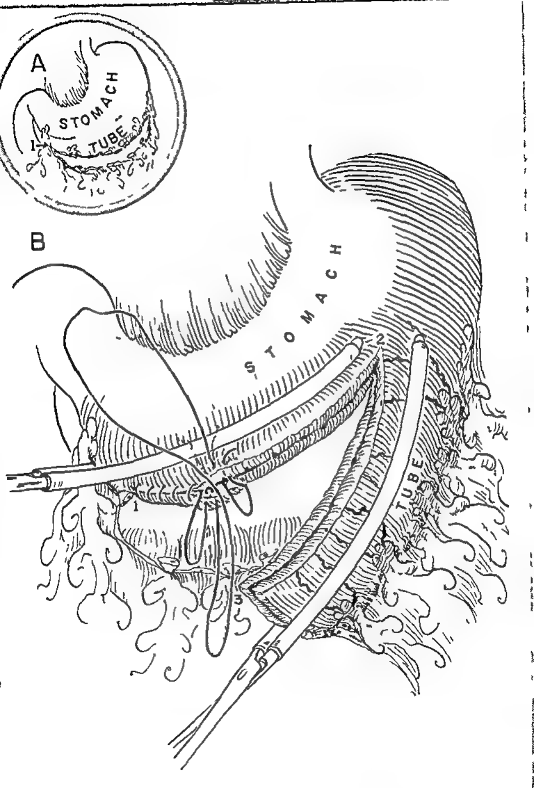
The special feature of the Beck Jianu gastrostomy is a mucosa lined tube which is brought up beneath the skin above the costal margin for a distance sufficient to provide a valvelike effect

A —A left paramedian incision (Plate 6) has been made The tube will be formed from the greater curvature and must be nourished by the left gastroepiploic vessel The flap is about 6 in long and 1 in wide It must be fashioned in such a manner as will permit closure of the remaining stomach without obstructing the lumen In small stomachs the incision must therefore be somewhat more to the left of the pylorus than usual Occasionally the stomach will be so small that this operation should not be attempted but a Spivack gastrostomy (Plate 24) done instead However manipulation usually increases the size of the stomach so that this procedure can be carried out The right gastroepiploic vessel is divided at point *1* adjacent to the antrum The gastrocolic omentum is then divided below the gastroepiploic vessels The outline of the tube is shown by the dotted line Care must be taken to keep the incision parallel to the greater curvature

B —Curved thin bladed clamps have been applied and the stomach divided between them The lower end of the tube is then swung away from the stomach and elevated toward the left The mucosal incision *1–2–3* can then be closed with a single continuous Connell suture

[Beck Jianu gastrostomy *continued on page 90*]

PLATE 23



C—The Connell suture has been completed Special care has been taken while rounding the acute angle at the base of the tube Following this suture the clamps may be removed

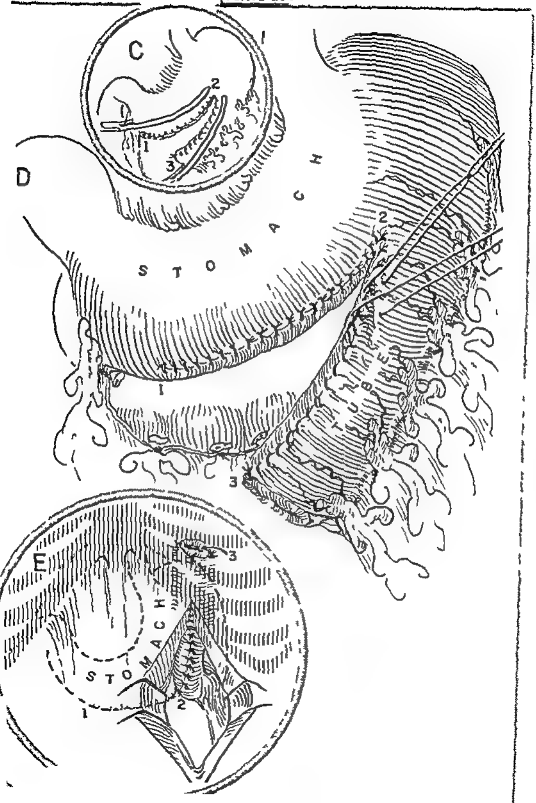
D—An outer layer of interrupted cotton or silk sutures of the Lembert type completes closure of the stomach and tube

E—An incision slightly over 1 in in length is made above the *costal margin and slightly to the left of the sternum By blunt* dissection a tunnel is made anterior to the rectus fascia and large enough to admit the gastric tube The tube is drawn tightly around the costal margin and as high as possible on the chest wall This will aid in prevention of regurgitation The tube is withdrawn about 1 cm above the skin and sutured to the incision

In this figure the final stage before closure of the abdominal wound is shown Note the final relations of the gastric suture line *1–2–3*

After care—A small catheter may be passed into the stomach within three to four days and feedings begun On conclusion of a feeding the catheter is withdrawn There may be a small amount of regurgitation but this is controlled easily by a small pad

REFERENCES Beck Jianu


C
1
2
1
3
D
STOMACH
2
TUBE
1
3
E
3
STOMACH
STOMACH
2
1

The essential feature of the Spivack gastrostomy is the formation of a valve at the base of the gastric tube thereby eliminating leakage

A —The valve is placed at the base of the flap The flap can be fashioned in any direction but should be about 2 in wide across the base and 3 in long If the stomach is very small the greater curvature can be cleared of the *gastroepiploic vessels and the flap extended* to the posterior wall usually however the entire flap can be cut from the anterior wall The base is placed near the lesser curvature At this point the gastric wall is depressed by a hemostat and the upper and lower margins adjacent to the hemostat are united by a row of interrupted sutures that catch the serosa and underlying muscle

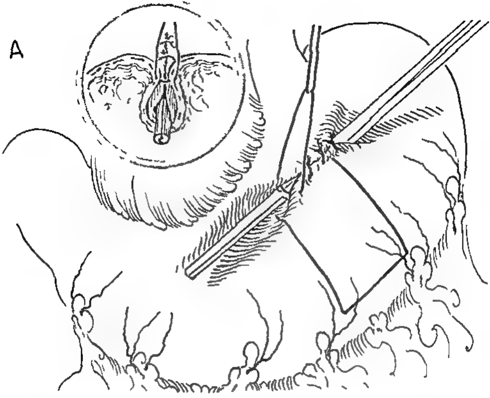
The insert in this figure shows a cross section of the valve which extends inward for a depth of about ½ in The hemostat is then withdrawn and *the flap outlined as shown*

B —The flap has been cut and the submucosal vessels have been caught and individually ligated with catgut This can be done without loss of blood if the seromuscular incision is made first and the submucosal vessels doubly ligated before the incision is carried through the mucosa The flap is elevated and the midportion of the greater curvature opposite it is caught with Allis forceps Tension on this clamp converts the rectangular defect to a triangle The stomach is then closed by a running suture begun at the greater curvature and extended upward for the entire length of flap thereby forming a mucosa lined tube

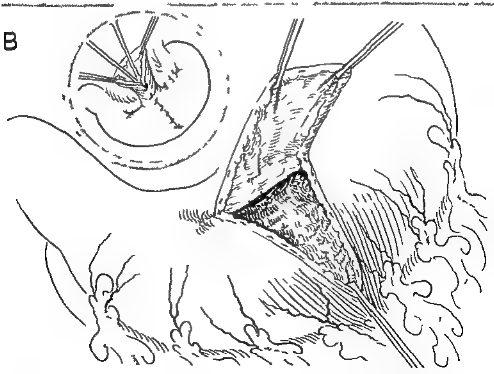
The insert illustrates the introduction of a hemostat into the tube to prevent suture of the valve to the anterior gastric wall as the suture is continued on the flap

[Spivack gastrostomy *continued on page 94*]

A



B



Spivack Gastrostomy

C—The running suture has been completed Two series of reinforcing sutures are now placed The first (*1*) consists of several interrupted sutures uniting the anterior surface of the tube to the stomach this increases the strength of the valve The second layer of sutures (*2*) is of the Halsted type of either cotton or silk and inverts the long suture extending from the greater curvature to the tip of the tube

Closure of the abdominal wall must be preceded by suture of the anterior gastric wall to the peritoneum This is accomplished with two sutures that catch the gastric wall just above and below the tube

D—A cross section shows the completed operation The various sutures that support the stomach and tube are

1 the primary suture forming the valve

3, the suture uniting the tube to the anterior rectus fascia

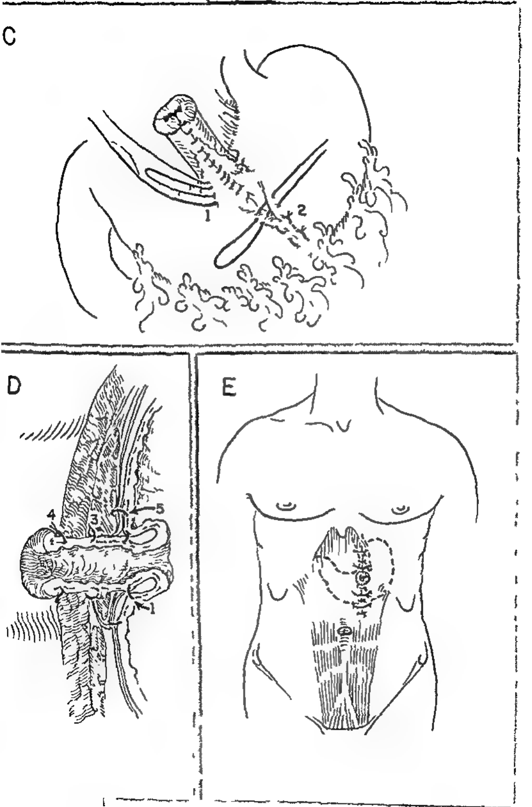
4 the suture uniting the tube to the skin and

5 the suture of the stomach wall to the peritoneum

Note that none of the sutures penetrates the mucosa The tube finally extends about 1 cm above the skin surface

E—The final appearance of the stoma is shown The tube is brought out through the midportion of the wound The incision is closed in layers

REFERENCE Spivack


C
1
2
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5
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E

SECTION 10

Diverticula of the Stomach and Duodenum

GASTRIC DIVERTICULA.—Diverticula of the stomach are comparatively rare. For example, Rivers, Stevens and Kirklin reported that only 10 were removed in 11,234 exploratory operations on the stomach at the Mayo Clinic. Diverticula occur most often on the upper portion of the lesser curvature just below the esophageal orifice. They vary considerably in size and shape; whereas they may be from 1 to 6 cm. long, they usually have a small neck that is about 1 cm. in diameter. Uncomplicated diverticula produce no symptoms. Diverticulitis, hemorrhage and malignant degeneration do occur.

Operation should be carried out if (1) the differential diagnosis is not clear and the lesion may be a large ulcer or cancer, (2) there are complications of diverticulitis or hemorrhage unrelieved by medical therapy or (3) the pedicle is narrow and the sac wide.

DUODENAL DIVERTICULA.—On the other hand, diverticula are encountered frequently in the duodenum. Maingot states that a fair assessment of the incidence in persons aged 50 and over is 5 per cent. This figure excludes the false diverticula that accompany the deformity resulting from a chronic duodenal ulcer. Other authorities find the incidence as high as 20 per cent above age 50. Obviously, therefore, most duodenal diverticula are asymptomatic, and the percentage that require removal is very small. However, severe complications may occur, such as diverticulitis with perforation, massive hemorrhage, retention of foreign bodies, malignant degeneration and obstruction of the common bile or pancreatic ducts.

Operation is indicated when any of these complications occur or

when the patient has severe upper abdominal symptoms for which no other cause can be established The retention of barium in a diverticulum for a period of 24 hours is not in itself sufficient indication for operation

Several operative procedures have been advised Serious technical problems are often encountered since the diverticula may be difficult to expose and identify They frequently originate from the vicinity of the ampulla of Vater and they often are more or less acutely inflamed

Exposure requires meticulous dissection If the diverticulum is collapsed Mahorner s maneuver may be necessary (Plate 26 B) Graham has used a duodenotomy introducing a finger through the open duodenum into the diverticulum Especially with diverticula of the third and fourth portions of the duodenum great care must be taken to avoid the right and middle colic arteries

When the neck of the diverticulum is near the ampulla of Vater the surgeon must be sure that the common duct is not constricted by the closure A choledochostomy may be required to assure patency of the duct

If the diverticulum is acutely inflamed particular care must be taken in closure of the neck Such a diverticulum cannot be inverted with safety since it may produce duodenal obstruction

Some of the commoner types of diverticula and their treatment are shown in the succeeding plates

FALSE DIVERTICULA —In contradistinction to the so called primary diverticula of the stomach and duodenum there is a group of secondary or false diverticula They follow adherence of the wall of the viscus to some adjacent area by scar tissue with subsequent contracture of the scar They are particularly common in the first portion of the duodenum after duodenal ulcer or repeated attacks of cholecystitis The treatment of the diverticulum thus produced is that of the causative disease

REFERENCES Maingot Rivers Stevens and Kirklin

A—Diverticula of the stomach are most often found near the cardia They may arise from the lesser curvature or from the anterior or posterior walls In the presence of diverticulitis they may be difficult to expose A transthoracic approach often is preferable when the diverticulum is high

B—The diverticulum has been dissected free and clamps have been applied to the base

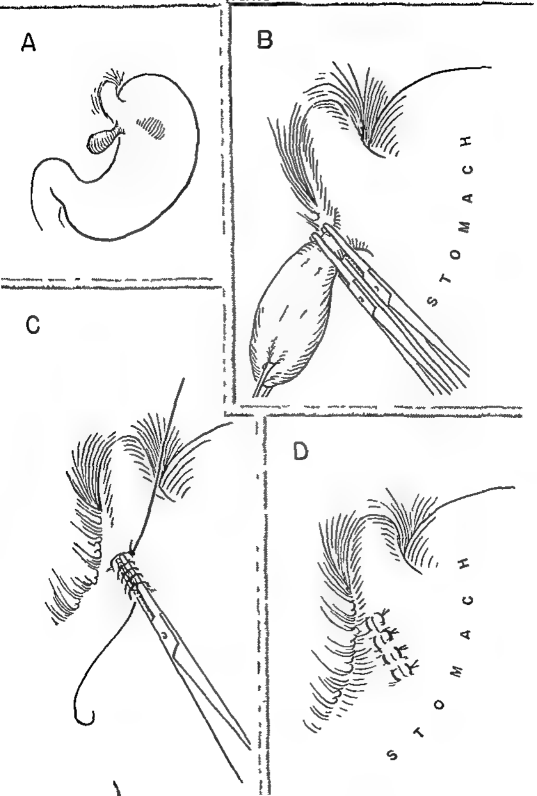
C—The diverticulum has been amputated Closure of the defect is carried out in two layers A running Cushing suture of 00 catgut on a nontraumatic needle is placed over the clamp As the clamp is withdrawn the suture is tightened Another bite is taken with the needle and the suture tied

D—An outer layer of interrupted sutures of cotton or silk has been placed and tied

Several important details may be mentioned If the diverticulum is near the esophagus special care must be taken to prevent encroachment on the lumen If the base of the diverticulum is large and particularly if it is near the left gastric artery the defect should be closed in an open fashion rather than over a clamp in order that hemostasis can be accurate Finally a pursestring closure is likely to produce poorer hemostasis than a linear closure and is not recommended

A special word is necessary about exposure of diverticula of the posterior wall that arise near the cardia It is in this group that the transthoracic approach is most satisfactory If the abdominal approach is used the surgeon must plan to free one of the gastric curvatures The suspensory ligament of the left lobe of the liver is cut and the lobe retracted If the diverticulum is near the lesser curvature the gastrohepatic omentum is opened and the left gastric artery divided and ligated between the celiac axis and the stomach If it is near the greater curvature the vasa brevia gastrosplenic ligament and upper half of the gastrocolic ligament are divided After mobilization the stomach can be rotated to demonstrate the diverticulum

PLATE 25



The identification and exposure of duodenal diverticula are often difficult Some of the methods that may be used are demonstrated in this plate

A —Occasionally the diverticulum is filled with vegetable pulp or other debris Then it can be palpated easily Here the diverticulum lies in the head of the pancreas Exposure has been secured by division of the gastrocolic omentum and reflection of the colon downward The diverticulum can then be dissected free When the base is as close to the ampulla of Vater as is shown here it is best to open the common duct and to identify its course accurately by Bakes dilators before turning in the base of the diverticulum

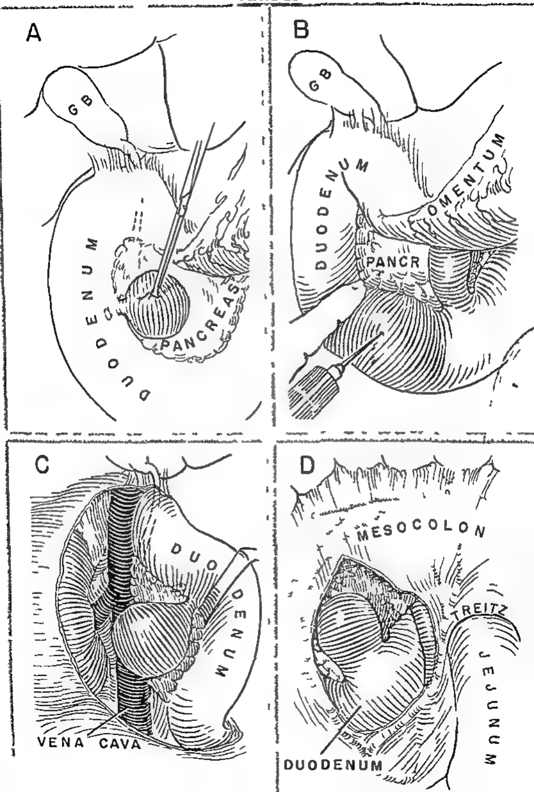
B —Mahorner s method The duodenum is mobilized but the diverticulum is collapsed and cannot be found Accordingly the duodenum is compressed with the finger and air is injected through a syringe On injection the diverticulum distends

C —Probably the commonest method of demonstrating a diverticulum is shown in this figure The entire descending duodenum is mobilized and reflected medially The diverticulum is usually intimately attached to the head of the pancreas The precautions to avoid injury to the common duct must be observed

D —Diverticula just proximal to the ligament of Treitz must be exposed by an opening through the transverse mesocolon Care must be taken to avoid injury to the midcolic vessels which must be retracted gently

REFERENCE Mahorner

PLATE 26


A
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DUODENUM
PANCREAS
B
GB
DUODENUM
OMENTUM
PANCR
C
DUO
DENUM
VENA CAVA
D
MESOCOLON
TREITZ
JEJUNUM
DUODENUM

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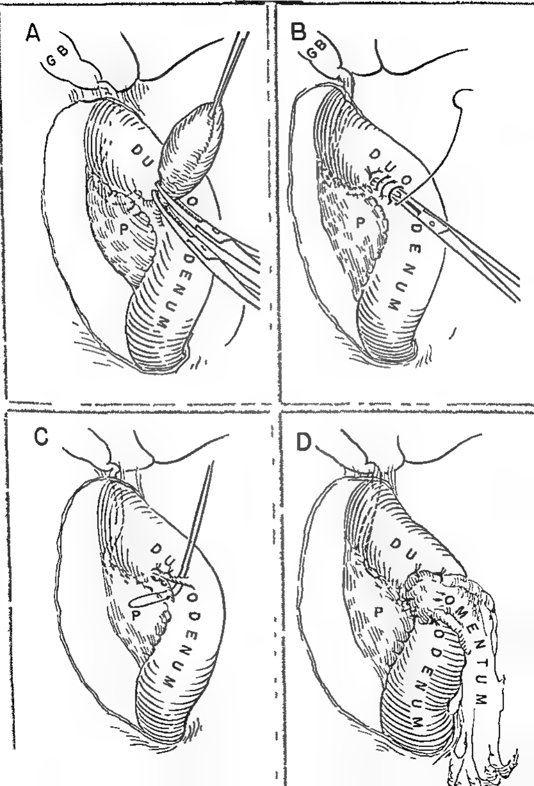
REFERENCE Mahorner

PLATE 27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ODENUM
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D
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OMENTUM
ODENUM
P

This plate illustrates the typical method of excision of a duodenal diverticulum exposure having been obtained by one of the procedures outlined on page 100

A —The diverticulum is seized with an Allis forceps and put under tension The neck is inspected It usually is narrow and can be treated in the manner illustrated It is grasped with two narrow hemostats and the diverticulum is amputated with a scalpel

B —A Cushing suture of 00 catgut is placed over the hemostat, the clamp withdrawn and the mucosa inverted by tension on the suture Another bite is taken with the needle and the suture tied completing the inner row

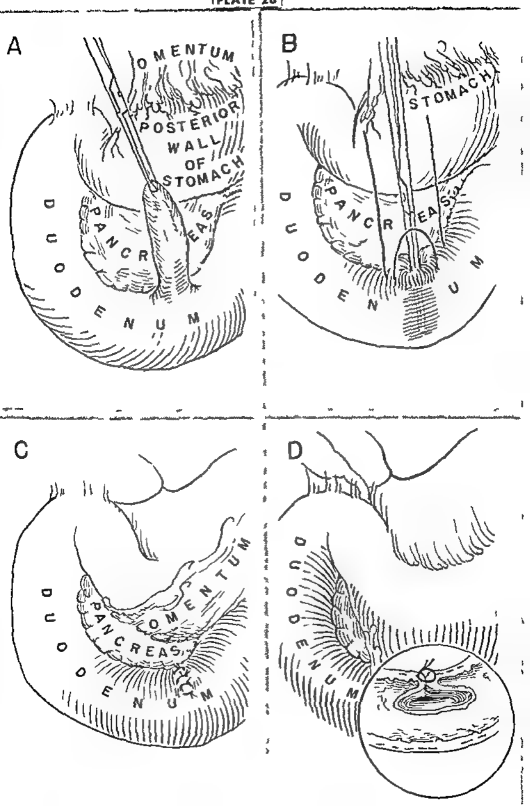
C —Interrupted nonabsorbable sutures either Lembert or Halsted type are used for the outer row

D —The suture line may be reinforced by a tag of omentum that is caught by several stitches

It should be noted that if the diverticulum has a wide base it must be treated differently It is excised in the same manner the clamp is then removed and transverse closure effected as illustrated for duodenotomy (Plate 19) This closure will prevent any constriction of the duodenal lumen by the suture

In the rare instance in which the diverticulum is found to be distended with vegetable pulp it is usually best to open and evacuate the diverticulum The surgeon s left index finger is then inserted into the open diverticulum as it is dissected

PLATE 28


A
OMENTUM
POSTERIOR WALL OF STOMACH
PANCREAS
DUODENUM
B
STOMACH
PANCREAS
DUODENUM
C
OMENTUM
PANCREAS
DUODENUM
D
DUODENUM

 Duodenal Diverticulum Inversion

Ferguson has suggested an easy method for the treatment of duodenal diverticula consisting of the simple inversion of the diverticulum Since the walls of these diverticula are thin consisting only of mucosa and submucosa the inversion produces little more than a hypertrophied fold of mucous membrane The normal fixation of the duodenum prevents any tendency toward intussusception This method is particularly applicable in locations where exposure and closure of the base of the excised diverticulum are difficult Also if the ampulla of Vater is near the base this operation will not compromise the common duct

A—The diverticulum is mobilized exposing normal duodenum above and below the base

B—With the Allis forceps the diverticulum is inverted within the duodenum The defect in the muscular wall is now repaired by a series of interrupted nonabsorbable sutures of the Lembert type These sutures penetrate the muscle and submucosa

C—The sutures have been tied closing the defect The stomach and gastrocolic omentum previously retracted upward are allowed to fall back into position at completion of the operation

D—A cross section shows the reconstructed duodenal wall and the inverted diverticulum

It must not be presumed that this procedure is applicable to diverticula in other portions of the intestinal tract When a diverticulum of jejunum or ileum is inverted it often behaves exactly like a polyp and initiates an intussusception

REFERENCE Ferguson and Cameron.

present on x ray examination but is not present unless esophagitis and scar tissue contracture have occurred

The *true short* esophagus occurs in about 5 per cent Gastric mucosa extends well into the chest and the esophagus actually is short Esophagitis ulcer and stricture develop at an early age

The *parahiatal type* comprises about 5 per cent Here the esophagus maintains its normal length and position The fundus of the stomach pushes into the chest very near but not actually through the hiatus The herniated stomach is completely enclosed in a true sac and as the hernia enlarges the entire stomach may be found in it

The indications for operation for hiatus hernia include

1 Persistent discomfort unrelieved by conservative measures such as loss of weight omission of corsets administration of a bland diet and antispasmodics The size of the hernia bears no relation to the amount of pain experienced by the patient

2 Evidence of blood loss With small hernias a persistently positive guaiac stool and secondary anemia occasionally are found With large hernias massive hemorrhage is not uncommon because ulcerations develop within them If blood replacement and phrenicectomy do not help an emergency operation with resection of the bleeding point and repair of the hernia will be necessary

3 Obstruction This may be either esophageal when stricture has followed an esophagitis due to a sliding hernia or gastric when the entire stomach is incarcerated in a parahiatal sac

4 Evidence of penetration or of subacute perforation of an ulcer within the hernia

Choice of approach —A good repair may be accomplished by either the transthoracic or the abdominal route The percentage of successful results roughly parallels the number of successful repairs although a few patients with excellent anatomical results will continue to have bizarre symptoms while a few with recurrence noted on x ray will be relieved of complaints The author prefers the thoracic approach for obese patients The abdominal approach is advisable if there is concomitant abdominal pathology such as gall stones or ulcer or in the presence of hemorrhage

SECTION 11

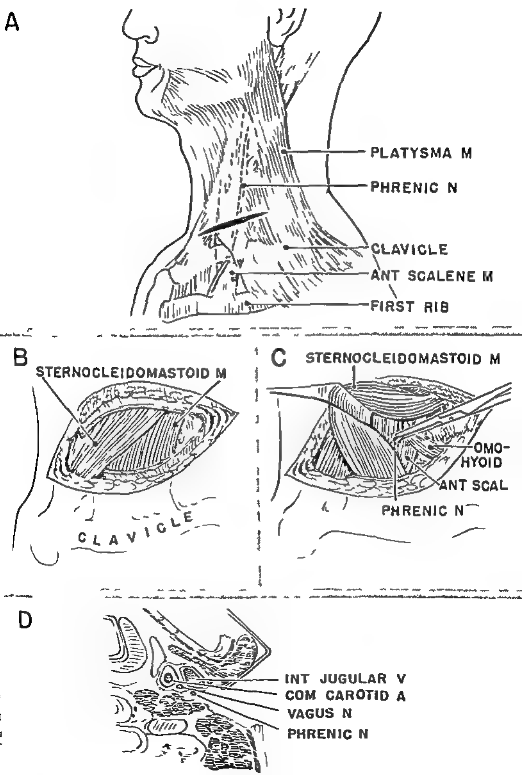
Hiatus Hernia

HERNIAS THROUGH THE DIAPHRAGM may be divided into several groups They include (1) hernias through or immediately adjacent to the esophageal hiatus (2) hernias due to traumatic lacerations of the diaphragm and (3) hernias through congenital defects The stomach may be involved in any of them but it is necessarily present in the hiatus hernias Since the hiatus hernias are the only common ones only brief mention will be made of the other types

Traumatic lacerations of the diaphragm may be due to penetrating wounds or to blunt trauma In the latter instance the lower ribs are often fractured as well The stomach may be involved in the defect immediately or several days to weeks later Severe pain and vomiting may be followed by gangrene and perforation if the stomach is incarcerated Repair is carried out through a transthoracic or abdominothoracic approach

Hernias through congenital defects are usually through the sinus of Morgagni Here the anterior leaf of the diaphragm is unattached to the costal cartilage in the parasternal area Repair is effected through an abdominal incision by suturing diaphragm to the intercostal cartilage Hernias through the sinus of Bochdalek occur in the muscular portion of the diaphragm near the periphery They are repaired by a transpleural approach Neither of these hernias has any peritoneal sac associated with it

Hiatus hernias may be divided into three important types The *sliding type* comprises about 90 per cent of all cases Here the entire cardiac portion of the stomach progresses into the chest through the hiatus The esophagus extends to the upper portion of the cardia in a normal fashion Shortening of the esophagus appears to be


A
PLATYSMA M
PHRENIC N
CLAVICLE
ANT SCALENE M
FIRST RIB
B
STERNOCLEIDOMASTOID M
CLAVICLE
C
STERNOCLEIDOMASTOID M
OMO-
HYOID
ANT SCAL
PHRENIC N
D
INT JUGULAR V
COM CAROTID A
VAGUS N
PHRENIC N

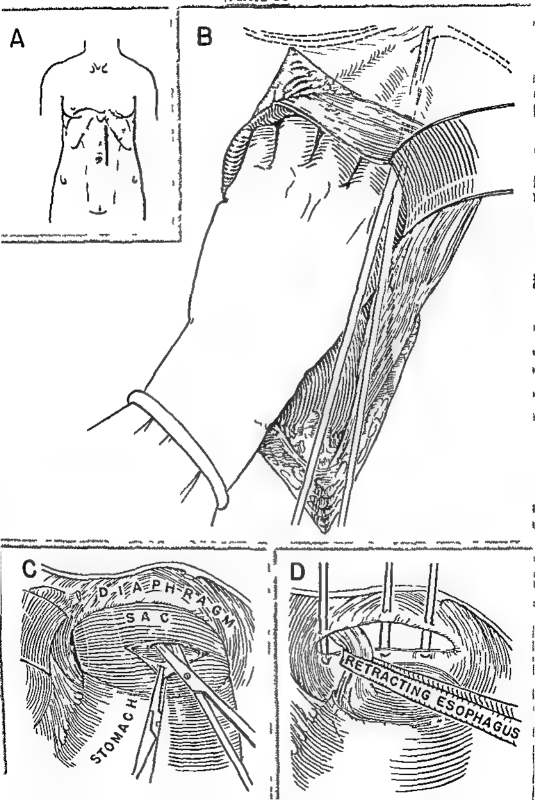
Formerly temporary phrenic nerve paralysis often was induced prior to the repair of most hiatus hernias when the abdominal route was chosen for the repair the nerve required crushing in the neck Because of the respiratory complications that may ensue preliminary crushing of the nerve now rarely is done if surgical repair of the hernia is contemplated However in poor risk patients it is sometimes possible to secure at least temporary relief from symptoms arising from a hiatus hernia by division of the left phrenic nerve in the neck

A—A transverse incision about 2 in long is made It crosses most of the sternocleidomastoid muscle and extends a short distance behind it It is placed about 1 in above the clavicle In this figure the relationship of the nerve to the anterior scalene muscle is shown The anterior scalene muscle inserts on the posterior margin of the first rib and the nerve lies immediately anterior to it Occasionally an accessory phrenic nerve will be found it must be crushed as well

B—*The skin incision has been deepened through the platysma* muscle The cut fibers retract with the skin exposing the underlying sternocleidomastoid muscle The posterior margin of the muscle is then dissected

C—The posterior belly of the sternocleidomastoid is retracted forward strongly The omohyoid muscle will be observed crossing the field immediately beneath The underlying vertical muscle that is exposed is the anterior scalene The phrenic nerve is identified and crushed once with a fine hemostat This will provide paralysis of the diaphragm for a period of about six weeks If permanent paralysis is desired the nerve should be cut The sternocleidomastoid is then allowed to fall back into place and the incision closed with skin clips

D—A cross section of the cervical region shows the relation of the phrenic nerve to the internal jugular vein the common carotid artery and the vagus nerve These structures lying within the carotid sheath normally are not exposed during the dissection but care must be taken to avoid trauma to them


A
B
C
DIAPHRAGM
SAC
STOMACH
D
RETRACTING ESOPHAGUS

The most difficult feature of the transabdominal repair of hiatus hernia is the production of an adequate exposure Long Deaver or Harrington retractors are necessary This operation was developed by Harrington his technic is illustrated in figures *A* to *F*

A —A left paramedian incision (Plate 6) is made that extends almost to the costal margin

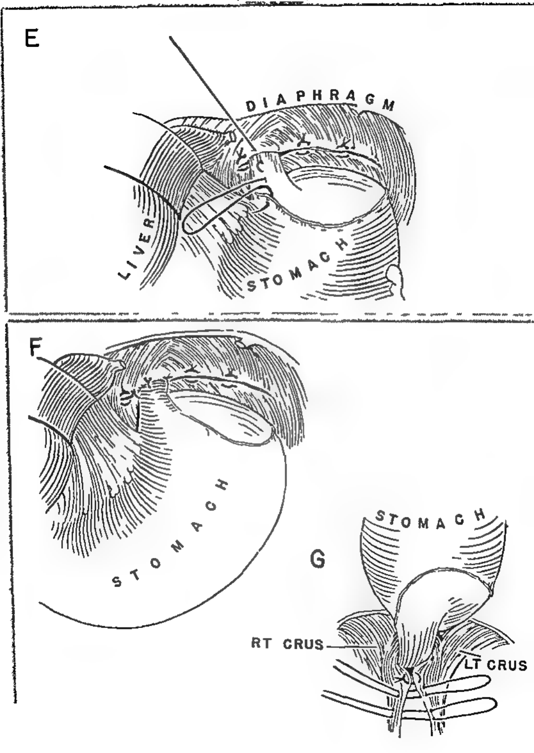
B —The left lobe of the liver must be reflected medially to expose the hiatus To do this the surgeon s left hand is introduced above the left lobe The supporting triangular ligament may be palpated and put on tension between the index and middle fingers The ligament can then be divided for a distance of about 3 in It is avascular but this division must be done under direct vision to avoid injury to the right inferior phrenic vessels The lateral margin of the left lobe may then be folded downward and the liver gently retracted by a well padded retractor

C —The index finger may now be passed into the hiatus and the margins of the muscular defect palpated The stomach is now pulled downward demonstrating the peritoneal sac that surrounds the anterior portion of the stomach and esophagus This fold of peritoneum is then grasped with forceps and opened with scissors

D —The esophagus and fundus of the stomach are exposed as soon as the peritoneum is opened The lower margin of the sac is trimmed away while the upper portion may be allowed to retract into the mediastinum With blunt finger dissection the esophagus is freed and drawn down with a traction tape Care is taken to avoid injury to the vagus nerves since motility disturbances of the stomach may result if both are cut Margins of the hiatus are denuded of loose areolar tissue and mattress sutures of 0 Deknatel are placed to close the defect.

[Transabdominal repair *continued on page 112*]

PLATE 30


E
DIAPHRAGM
LIVER
STOMACH
F
STOMACH
G
STOMACH
RT CRUS
LT CRUS

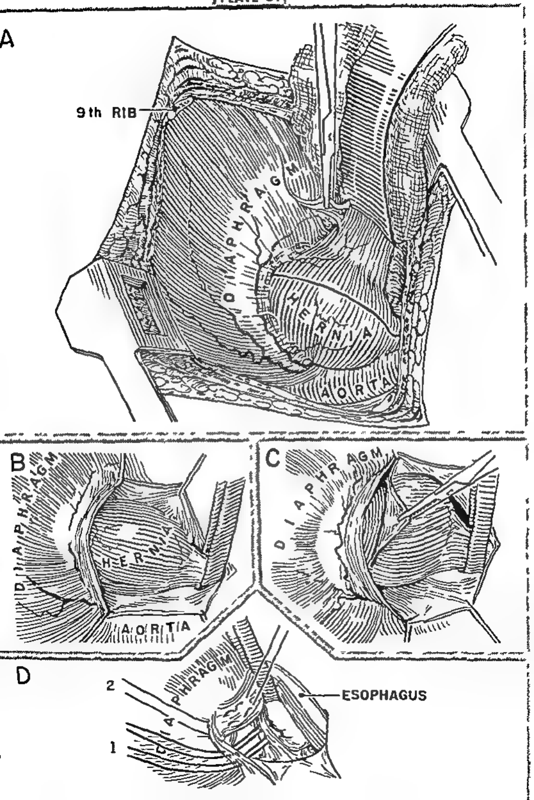
E—The heavy silk sutures have been tied obliterating the diaphragmatic defect The sutures must be snug but not so tight that they obstruct the esophagus It should be possible to pass the distal phalanx of the index finger beside the esophagus through the reconstructed hiatus Finally the stomach is sutured to the hiatus by a series of pleating sutures of 00 Deknatel that surround the esophagus Each suture passes through the diaphragm catches the lower esophagus and then the wall of the stomach at the cardia Two sutures may be laid posteriorly and three anteriorly They are all placed first the posterior and then the anterior are tied

F—The second row of sutures has been tied thereby completing the repair The abdomen is now closed without drainage

G—Instead of repair by sutures placed lateral to the esophagus a more anatomical method involves closure of the abnormal hiatus by suture of the two crura posterior to the esophagus This is the method preferred by the author After mobilization of the liver stomach and esophagus as in *A–D* the right and left crura are developed by blunt dissection Exposure of the right crus follows division of the upper portion of the gastro hepatic ligament The crura then are brought together snugly behind the esophagus with 0 Deknatel sutures The closure can be made so tightly that the esophagus is occluded to avoid this sufficient space should be left for the introduction of the tip of the index finger alongside the esophagus Finally the stomach is returned to its normal position and the cut margin of the sac or the fundus is anchored to the diaphragm about 1 cm anterior to the hiatus by several 000 Deknatel sutures It will be seen that this operation corresponds to an Allison repair except that it is performed through an abdominal approach and that major emphasis is laid upon a tight closure of the crura

After care—Special attention must be paid to the thoracic cavity during and after operation since it is possible to produce a pneumothorax during the dissection The stomach is kept empty by a Levin tube and fluids by mouth are restricted until postoperative ileus has been relieved

REFERENCE Harrington


A
9th RIB
DIAPHRAGM
HERNIA
AORTA
B
DIAPHRAGM
HERNIA
AORTA
C
DIAPHRAGM
D
DIAPHRAGM
2
1
ESOPHAGUS

A—The left chest has been opened through the bed of the resected ninth rib (Plate 10) The lung is retracted with a gauze pack The phrenic nerve may be pinched with a hemostat where it nears the diaphragm The esophagus apparently has been shortened and the hernia is seen above the diaphragm

Several methods are now available for repair The sliding hernia will be illustrated since it is the most common In the first type (B–E) the diaphragm is not opened but the hernial sac is entered excess sac removed and the hernia reduced Reduction is maintained by a row of pleating sutures at the cardia and strong sutures that unite the crura behind the esophagus

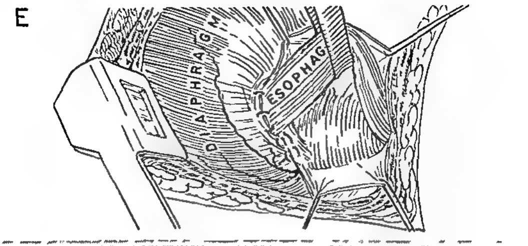
B—The hernia and esophagus are developed after division of the thin mediastinal pleura The esophagus is retracted with a tape and the hernia is freed from surrounding attachments particularly to the diaphragm The esophagus must be mobilized high enough to allow replacement of the cardia which is at the upper end of the hernia below the diaphragm

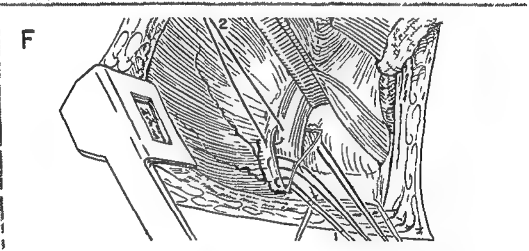
C—The hernial sac has been opened Since this is a sliding hernia there is no sac on the posterior wall of the stomach The excess sac is excised leaving the margin over the attachment to the esophagus to aid in the repair

D—The sac has been excised and the stomach completely separated from the hiatus Both crura must be freed by blunt dissection Repair is being effected by two rows of sutures Row *1* joins the crura behind the esophagus Row *2* is a series of five or six quilting sutures uniting the esophagogastric junction to the diaphragm at the hiatus It is best to place both rows of sutures first, and then tie down *1* and *2* respectively Row *1* is made of interrupted mattress sutures of 0 Deknatel row 2 consists of 00 Deknatel sutures

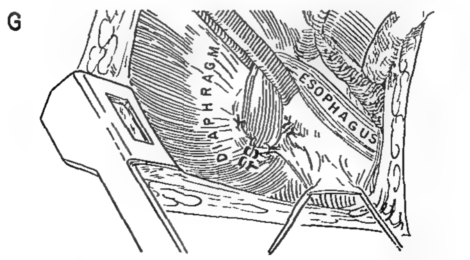
[Transthoracic repair *continued on page 116*]

PLATE 31





ALTERNATIVE METHOD



E—The sutures have been tied completing the repair The repair must be snug but must not constrict the esophagus Thereafter the mediastinal pleura may be sutured and the wound closed

The second method of repair (F–G) is the counterpart of the abdominal repair shown in Plate 30 It is not as satisfactory as the first method but may be used whenever strong tissues are available for suture lateral to the esophagus This occurs more commonly with the parahiatal than with the sliding hernias

F—Exposure of the esophagus and hernial sac is carried out in the usual way The sac has been excised and the hernia reduced Repair of the defect is made by a series of interrupted mattress sutures of *0 Deknatel (1) The* esophagogastric junction is sutured to the hiatus by a series of 00 Deknatel sutures that surround the esophagus (2)

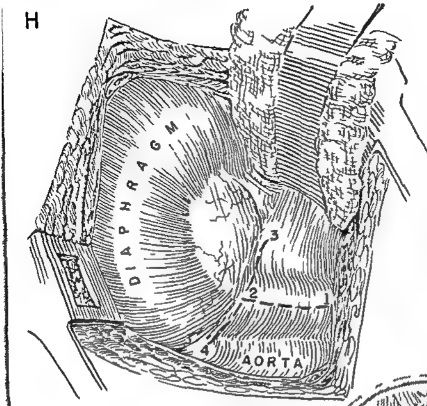
G—The sutures have been tied finishing the repair The mediastinal pleura then may be sutured anterior to the esophagus

The repair of the hernia usually is not difficult when there is no inflammation about the lower esophagus Any inflammatory reaction in the sac or esophagitis make the repair hard because it is difficult to lengthen the esophagus sufficiently to retain the stomach below the diaphragm To secure reduction it may be necessary to cut the vagus nerves This is not an unmixed blessing for postvagotomy effects may be severe in these patients so that a secondary drainage operation such as pyloroplasty becomes necessary

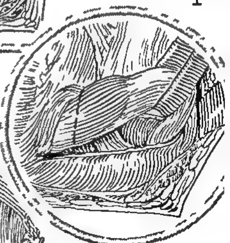
Another suggestion has been offered by Merendino Since the dome of the diaphragm rises anteriorly it is possible to transplant the esophagus anteriorly and secure reduction in this fashion To do this an incision 4–5 cm long is made running anteriorly from the esophagus dividing the encircling muscle of the diaphragm running about the hiatus After repair the crura and diaphragm must be sewed snugly behind the esophagus

[Allison s method of repair *on page 118*]

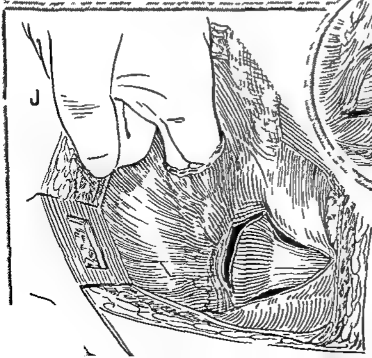
H



I



J



Allison's Method

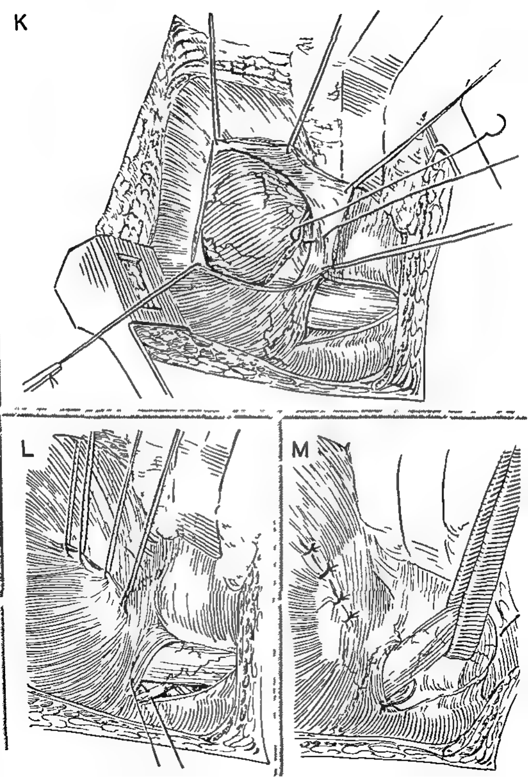
Allison has presented a method of repair that has become very popular The essential feature is that the esophagus is maintained in position by a row of sutures placed on the under side of the diaphragm

H—The usual transthoracic approach has been made A T shaped incision (shown by dotted line) now divides the mediastinal pleura By dissecting it back the esophagus and hernia will be exposed

I—The esophagus and hernial sac have been mobilized A sliding hernia is illustrated so that the sac covers only the anterior and anterolateral surfaces of the cardia The crura also are mobilized by blunt dissection If an incision is now made along the dotted line just below the upper end of the sac Allison has noted that two separate planes of tissue—the esophagophrenic ligament and the peritoneum—will be cut For most surgeons this will be a single layer

J—A counter incision is now made through the tendinous portion of the diaphragm This must be long enough to allow good visualization and if necessary withdrawal of the stomach for inspection With the finger one can now elevate the anterior ring of muscle about the hiatus and then open the sac just below the lower end of the esophagus Note that some of this sac (or ligament and peritoneum) is left attached to the esophagus It is important that the ring of muscle surrounding the hiatus be kept intact and not divided

[Allison's method of repair *continued on page 120*]


K
L
M

K—The essential portion of the repair now consists of a series of sutures that unite the cut edge of the sac to the under side of the diaphragm about 1 cm away from the actual hiatus In this drawing the thickness of the sac is exaggerated to show the location of the sutures These sutures are of 000 Deknatel Meanwhile the open diaphragm is retracted by stay sutures

L—Allison has considered the apposition of the crura behind the diaphragm a relatively unimportant step However, a stronger repair can be accomplished if this is done Here one 0 Deknatel suture is used to close the crura

M—The crura now enclose the esophagus moderately snugly One or more similar sutures may be necessary Finally the diaphragm is closed The mediastinal pleura may be sutured anterior to the esophagus

To complete a discussion of the methods of repair of these hiatus hernias it may be mentioned that in contrast to this meticulous repair some surgeons do not open the sac but obliterate it by a series of pleating sutures Allison s method has several obvious advantages that include a stronger anatomical and better physiological repair as well as an opportunity to inspect the stomach In addition it may be mentioned that blind pleating without opening the diaphragm may catch the gastric wall at an inopportune level or even transfix the lower portion of the lesser curvature inadvertently

REFERENCE Allison

the esophagus above the stricture and the gastric cardia (4) resection of the strictured esophagus with esophagogastrostomy (5) resection of the lower portion of the redundant megaesophagus with esophagogastrostomy Of these methods the first is the simplest and is apparently as effective as the more radical procedures A resection of the entire strictured area is a much more difficult procedure and is more dangerous from the point of view of healing More extensive resections of the megaesophagus apparently do not offer additional advantages

The operation of esophagomyomotomy originally described by Heller now is being used more widely in this country Maingot recommends it highly It is an operation analogous to the Rammstedt operation for congenital pyloric stenosis and because of the delicate esophageal wall must be performed with the utmost care

Preoperative preparation —Since the patients are often in poor physical condition special attention should be given to their preoperative preparation In certain instances a temporary gastrostomy may be necessary Before operation the huge esophagus should be emptied of retained food and liquid content to prevent aspiration during anesthesia Repeated aspirations and irrigations are often necessary to clear it.

Postoperative care —Postoperatively patients are maintained on antibiotics Oral intake is increased very slowly Sips of water up to 30 cc an hour are permitted the first postoperative day A gradual increase in amount will allow a full liquid diet in eight days and soft solids in two weeks

Complications —The postoperative complications are nearly all referable to the suture line However occasionally severe anemia is encountered This is probably due to bleeding from an esophageal ulceration that follows an acute esophagitis produced by a reflux of gastric contents through the patulous cardia into the vulnerable esophagus

The reader is referred to the exhaustive review by Ochsner and DeBakey for a complete discussion of the problem

SECTION 12

Pyloroplasty and Cardioplasty

THESE TWO OPERATIONS are discussed together since similar types of procedures are used However the underlying pathology is entirely dissimilar

PYLOROPLASTY —Pyloroplasty was first described and advised as a specific operation for duodenal ulcer especially when cicatricial obstruction of the proximal duodenum was present Experience has shown that recurrences are frequent when this is the only procedure However the principle of the conversion of a stenosed lumen to a wider one may be applied here as well as to other anatomical locations

At present pyloroplasty is occasionally used to relieve gastric stasis Thus in conjunction with vagotomy pyloroplasty may be used in place of gastroenterostomy After esophageal resection with a high anastomosis the stomach which is in large part converted to a thoracic organ and is atonic from vagus section often empties poorly a pyloroplasty improves this condition

CARDIOPLASTY —The cause of cardiospasm or as it is better termed achalasia of the esophagus is not clear The great majority of patients respond well to psychic or medical treatment most of the rest are treated satisfactorily by dilatations with a mercury bougie and a few require surgical intervention The patients in the last group usually have a hugely dilated esophagus that tapers rapidly to an area of almost complete stenosis just above the cardia

Operative procedures —The operations that have been performed for this lesion include (1) esophagomyomotomy (Heller s operation) (2) Sweet s method of esophagocardioplasty (3) esophagogastrostomy with the production of a side to side anastomosis between

the esophagus above the stricture and the gastric cardia (4) resection of the strictured esophagus with esophagogastrostomy (5) resection of the lower portion of the redundant megaesophagus with esophagogastrostomy Of these methods the first is the simplest and is apparently as effective as the more radical procedures A resection of the entire strictured area is a much more difficult procedure and is more dangerous from the point of view of healing More extensive resections of the megaesophagus apparently do not offer additional advantages

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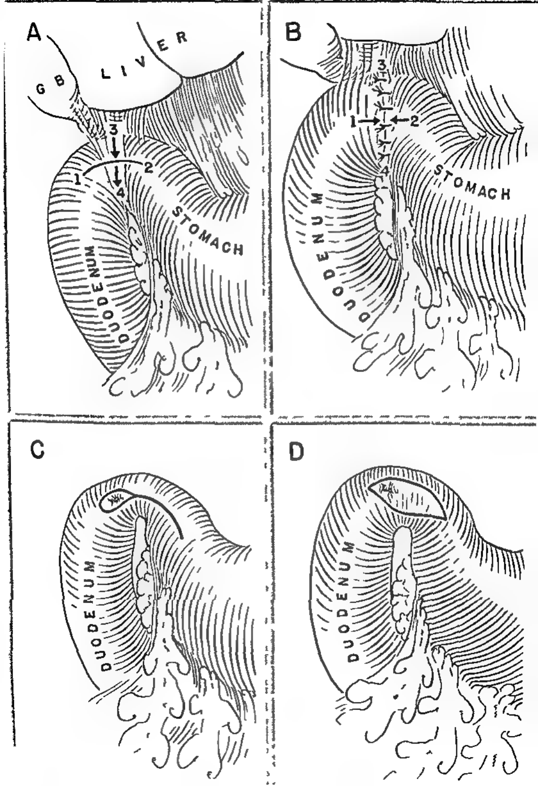
PLATE 32


A
G B
L I V E R
3
1
2
4
DUODENUM
STOMACH
B
3
1
2
4
STOMACH
DUODENUM
C
DUODENUM
D
DUODENUM

Several types of pyloroplasty have been described which are now of interest chiefly because of their historical importance Formerly widely used as the operation of choice for duodenal ulcer these procedures have been almost universally discarded They now are used rarely to correct gastric stasis after any operation in which the vagus nerves have been cut or in an old patient with cicatricial pyloric obstruction from a burned out duodenal ulcer

A—The *Heineke Mikulicz operation* is the simplest plastic procedure to relieve pyloric obstruction An incision is made through the anterior wall of duodenum and stomach (*1–2*) extending about 3 cm on either side of the pylorus midway between the greater and lesser curvatures After the incision is made traction sutures are inserted in the midpoint of the upper and lower margins of the incision (*3* and *4*)

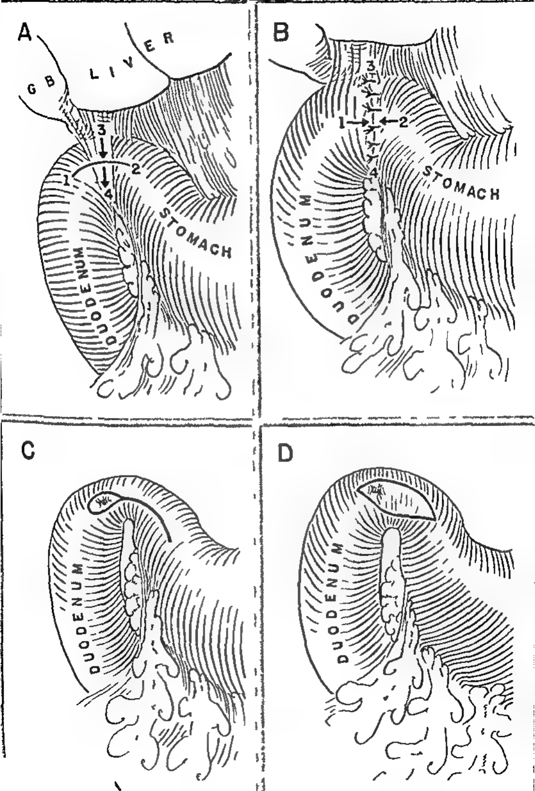
B—The longitudinal incision is converted to a vertical incision by traction on sutures *3* and *4* Closure is effected by two layers of sutures

C—*Horsley s pyloroplasty* combined the same type of plastic procedure with excision of an anterior wall duodenal ulcer The duodenal incision was made 2 5 cm in length and the gastric incision twice as long The incision is closed vertically in two layers and the suture line reinforced with omentum

D—*Judd s pyloroplasty* was slightly more extensive An elliptic incision was made across the pylorus that included the anterior duodenal ulcer the anterior two thirds of the pyloric sphincter and a portion of adjacent pyloric antrum

REFERENCES Heineke Mikulicz Horsley Judd

PLATE 32


A
G B
L I V E R
3
1
2
4
STOMACH
DUODENUM
B
3
1
2
4
STOMACH
DUODENUM
C
DUODENUM
D
DUODENUM

Finney's operation combines a plastic procedure on the pylorus with a gastroduodenostomy It will produce a larger stoma than those shown in Plate 32 but requires a duodenum that is freely mobile so that it may be apposed easily to the pyloric antrum If free mobilization cannot be secured the operation should not be used

A—The duodenum has been freed by the methods outlined in Plate 16 Three guide sutures are then placed uniting the greater curvature of the stomach to the inner margin of the duodenum The upper suture is placed just below the pylorus the second about 8 cm below the pylorus near the lower end of the descending portion of the duodenum and the third midway between them These sutures are tied and cut This will produce a gastroduodenostomy that is probably unnecessarily long and it may be made shorter if desired

B—It is best to use an outer layer of interrupted cotton or silk and an inner of continuous 000 catgut Accordingly stomach and duodenum are sutured just anterior to the traction sutures with a row of interrupted nonabsorbable sutures forming the outer posterior row The anterior walls of the duodenum and stomach are then opened through the inverted U shaped incision *1–2–3*

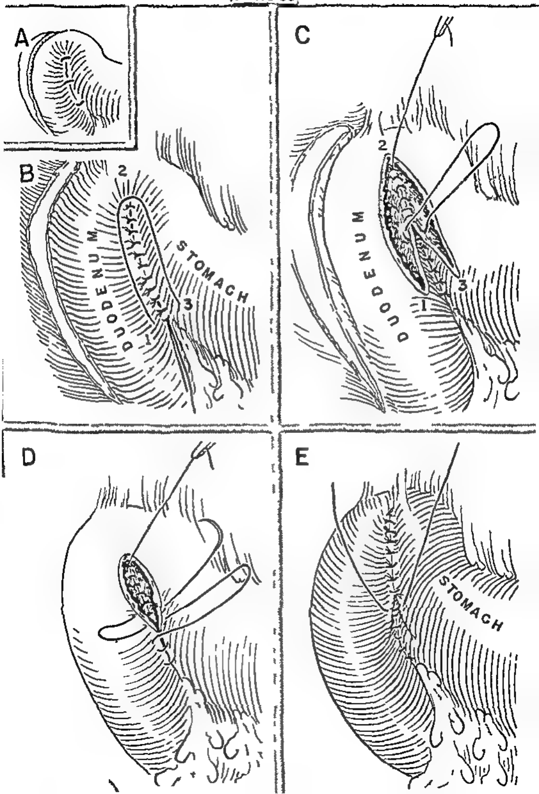
C—The posterior inner row is being placed starting from point 2 and continuing downward At the lower end *1* is sutured to *3* and the suture locked

D—The anterior inner row is then laid running from the lower angle of the incision back to the pylorus where it is tied A Connell suture is used for this portion

E—The outer anterior row is being placed After its completion omentum will be used as a reinforcement

REFERENCE Finney

PLATE 33



Cardiospasm is much more aptly termed achalasia of the esophagus as Sweet has pointed out since the area of stenosis is uniformly located a short distance above the cardia Operations for its relief have not been performed frequently since in most patients improvement will follow relief of psychic factors antispasmodics and occasional bouginage When these measures fail some type of plastic procedure must be considered In general these procedures are similar to the operations for pyloric obstruction

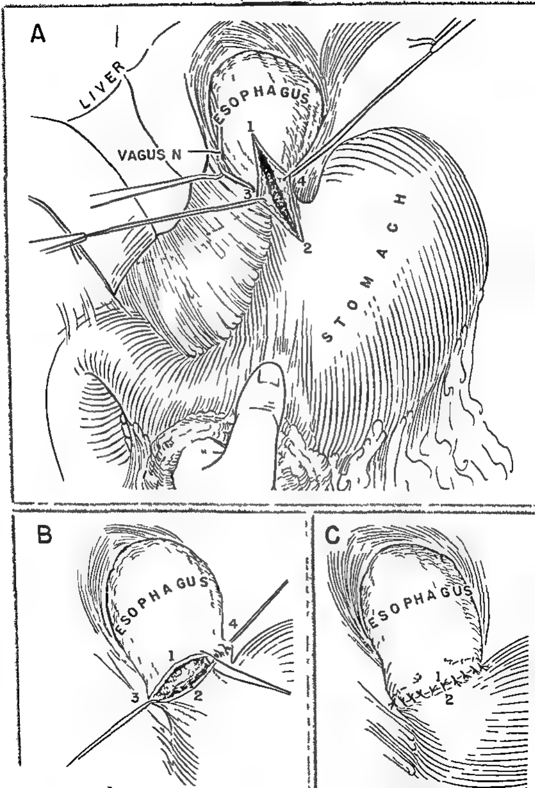
In the Massachusetts General Hospital good results have been secured by Sweet s operation which embodies the features of the Heineke Mikulicz pyloroplasty The operation is preferably performed through a thoracic approach but as illustrated here may be done through the abdomen The thoracic approach is superior in that an unexpected cancer of the esophagus is occasionally found

A —*The left lobe of the liver has been freed and is displaced by* a Deaver retractor The peritoneum over the esophageal hiatus has been opened and the esophagus mobilized by gentle digital manipulation The vagus nerves are identified and retracted The anterior nerve is particularly likely to be injured and must be protected to avoid later problems of gastric motility The stenotic area in the lower esophagus is identified just above the cardia and an incision is made through the anterior wall of esophagus and stomach The incision centers over the stenosis and extends about 3–4 cm on either side (*1–2*) If large veins are encountered in the submucosa they must be ligated with fine silk Traction sutures (*3 4*) are inserted on either side of the midpoint of the incision

B —The esophagus can now be rotated by the traction sutures and the incision is closed transversely with three layers of fine silk Lembert sutures The inner mucosal row is being placed

C —The third row has been completed Reinforcement may be secured with omentum

REFERENCE Sweet


A
LIVER
ESOPHAGUS
VAGUS N
1
2
3
4
STOMACH
B
ESOPHAGUS
1
2
3
4
C
ESOPHAGUS
1
2

The simple plastic procedure just described is easy to perform, but it has been followed in a number of instances by reflux esophagitis that produces either bleeding or pain It now seems probable that Heller s operation of esophagocardiomyomotomy is likely to give better long term results

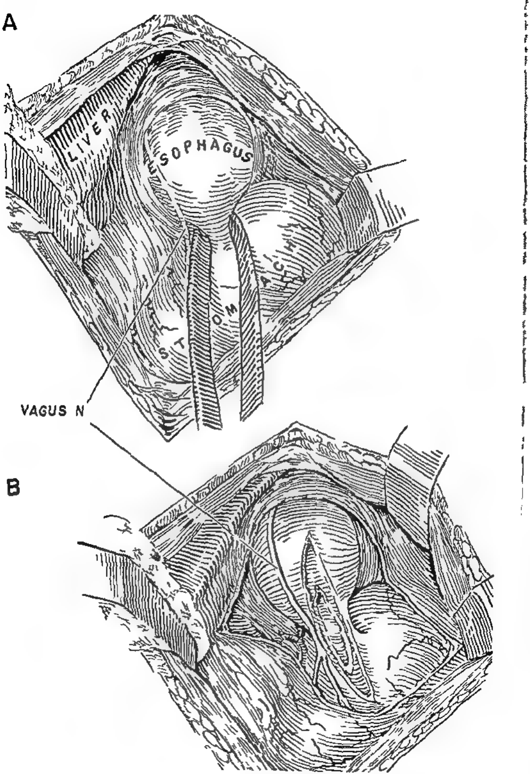
A —The first step consists in the mobilization of the lower esophagus and fundus of the stomach The left lobe of the liver has been retracted after cutting the suspensory ligament and the peritoneum over the esophagus It is important to identify and spare the vagus nerves to eliminate any postoperative gastric stasis A traction tape is passed around the lower esophagus to aid in mobilization

(After this mobilization several methods of repair are available *in addition* to the plastic repair described in *Plate 34 Heller s op*eration (*B*) and an alternative procedure (*C–F*) which is less satisfactory are illustrated)

B —The operation involves merely the longitudinal incision of the muscular coats of the esophagus and stomach for a distance of 3 in in the esophagus and 2 in in the stomach The incision must be made with great care The esophagus is opened first dividing *the longitudinal* and then the thin circular muscles Small veins lying on the mucosa may need ligation The incision is then extended on the stomach Finally the stomach is squeezed to be sure no bubbles appear through an injured esophagus If a perforation is found it is closed by fine sutures As a guide to determine whether or not all muscular fibers have been cut, a short gastrotomy incision may be made below the vertical incision and the index finger introduced into the esophagus A Foley catheter can also be inserted in the same manner the 30 cc balloon inflated and then withdrawn into the *stomach*

REFERENCES Heller Maingot

[Esophagogastrostomy for achalasia *on page 132*]


A
LIVER
ESOPHAGUS
STOMACH
VAGUS N
B

A lateral anastomosis of dilated esophagus to stomach has been used by many surgeons to correct achalasia This procedure however is almost certain to produce reflux esophagitis and is inferior to the Heller operation It is included here because of its historical interest

Two methods of esophagogastrostomy are available A simple side to side anastomosis used by some surgeons unites the stomach and esophagus above the stricture which is left undisturbed This may produce a short and somewhat precarious anastomosis with a malfunctioning stoma because of the spur The second method using the principle of the Finney pyloroplasty is illustrated as it has been performed by Clagett

C —A row of interrupted silk sutures (*1*) has been placed uniting the stomach to the esophagus The anterior walls of stomach and esophagus are now opened by a U shaped incision that extends directly through the area of the stenosis The two arms of the U must be long enough to produce an adequate stoma but should not be carried too close to the upper end of row *1* Hemostasis is then effected The inner posterior row of sutures (*2*) is now placed The suture of continuous 000 catgut is started at the upper end and unites the inner walls of the U The suture passes through the full thickness of both gastric and esophageal walls It is knotted the short end cut and the suture continued down to the base of the U

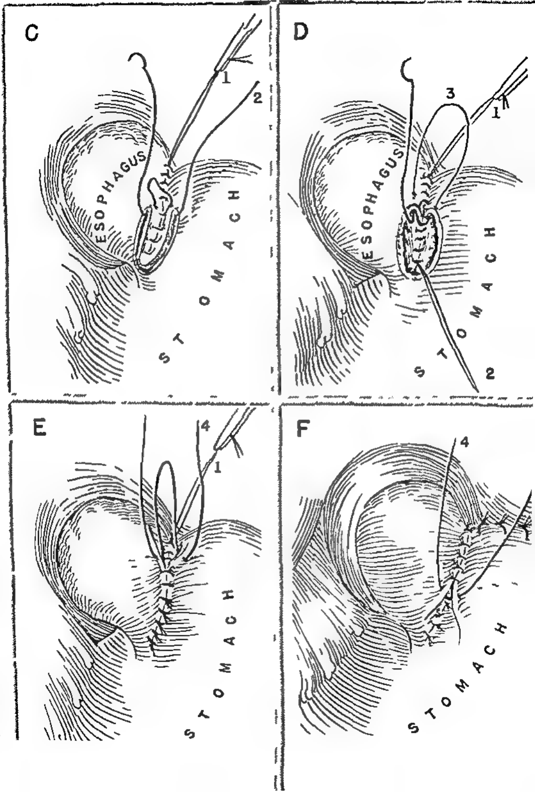
D —The posterior mucosal row (*2*) has been completed and the tied end is held in a hemostat until the first few anterior sutures are taken The anterior inner row (*3*) unites the outer sides of the U incision

E —The anterior inner row has been completed and tied The anterior outer row is being placed (*4*)

F —The outer row is being completed It may be possible to insert a third anterior row and this should afford a stronger anastomosis However care must be taken to avoid rolling in too large a diaphragm Relief from tension on the anastomosis may be secured by several sutures that anchor the fundus of the stomach to the diaphragm

REFERENCES Clagett Ochsner and DeBakey

PLATE 35


C
1
2
ESOPHAGUS
STOMACH
D
3
1
ESOPHAGUS
STOMACH
2
E
4
1
STOMACH
F
4
STOMACH

SECTION 13

Side-to-Side Anastomoses

THE PRINCIPLES OF side to side or end to end anastomosis are the same regardless of the location in the gastrointestinal tract However so far as the stomach and duodenum are concerned, the various exposures involved make it necessary to describe the several types which may be used with these viscera

Esophagogastrostomy—An operation occasionally performed for achalasia is a side to side anastomosis of the lower dilated esophagus to the cardia This operation is inferior to those described for cardioplasty (*Plates 34* and *35*)

Gastrogastrostomy—A sleeve resection of the stomach is carried out most commonly for a benign tumor of the midportion of the organ Gastric continuity is then restored by uniting the open ends of the stomach

Gastroduodenostomy—This operation formerly was performed as a definitive procedure for ulcer, as such it was unsatisfactory It has also been used to restore continuity after a minimal resection of the stomach and as a concomitant operation with vagotomy to prevent gastric retention

Gastroenterostomy—For relief from pyloric obstruction of any type or to relieve gastric atony after vagotomy *gastrojejunostomy is a favorite operation* Gastroenterostomy is not indicated for the treatment of nonobstructing duodenal ulcer The gastroenterostomy may be placed either in a retro or antecolic position the former provides more dependent drainage and is usually preferred An antecolic gastroenterostomy is easier to make and to take down it is indicated in some cases of extensive cancer of the stomach as the only possible palliative operation Some surgeons have recommended it as a first

stage operation for unresectable duodenal ulcers to precede an adequate gastric resection However for that purpose the two stage resection is to be preferred Gastroenterostomies are "anterior" or "posterior depending on whether the anterior or posterior gastric wall is used In addition they are antecolic when the jejunal loop is brought in front of the transverse colon and retrocolic" (or "postcolic) when brought behind it

Duodenojejunostomy—Obstruction of the duodenum by compression of the superior mesenteric vessels at the ligament of Treitz produces a megaduodenum that may be treated by this procedure However this diagnosis must be regarded with some caution since this duodenal dilatation is often part of a general intestinal dilatation the cause of which is not clear

Method—In general it may be said that it is wiser to use three layers of fine nonabsorbable sutures when dealing with the esophagus With stomach duodenum and jejunum two layers are sufficient Although both layers may be of fine catgut best results seem to be obtained with an outer layer of interrupted cotton or silk and an inner layer of continuous 000 catgut on a nontraumatic needle The inner layer may also be made with interrupted sutures It must be remembered that continuous sutures when pulled tightly have a pursestring effect so that when one or both viscera to be anastomosed have small lumens interrupted sutures should be used

Complications—The complications referable to these procedures are hemorrhage leakage and obstruction To prevent bleeding individual vessels are caught with hemostats and ligated with 000 catgut Hematomas must be avoided Leakage can be avoided only by delicate technic lack of trauma careful approximation and complete hemostasis

Obstruction formerly was common when large sizes of catgut were used Its incidence is diminished by use of fine sutures by proximal decompression postoperatively and by maintenance of normal serum protein and electrolytes However it still is the most important complication of these operations Occasionally despite technical perfection particularly in an elderly patient who has had a posterior gastroenterostomy for an obstructed ulcer serious stomal malfunction may occur In such patients who have a narrow nutritional reserve it is wise to supplement the original operation by double jejunostomy (Plate 70)

There are numerous variations of the gastroenterostomy operation These modifications assumed much more importance before gastric resection became the surgical procedure of choice for benign ulcer and there seems to be little value in describing all the methods since most have been abandoned The surgeon must decide primarily whether he wants to use an anterior or a posterior gastroenterostomy The anterior is simpler technically but requires a longer loop and postoperatively attacks of vomiting may occur from distention of the afferent jejunum Usually the anterior gastroenterostomy is placed in an antecolic position while the posterior gastroenterostomy is retrocolic

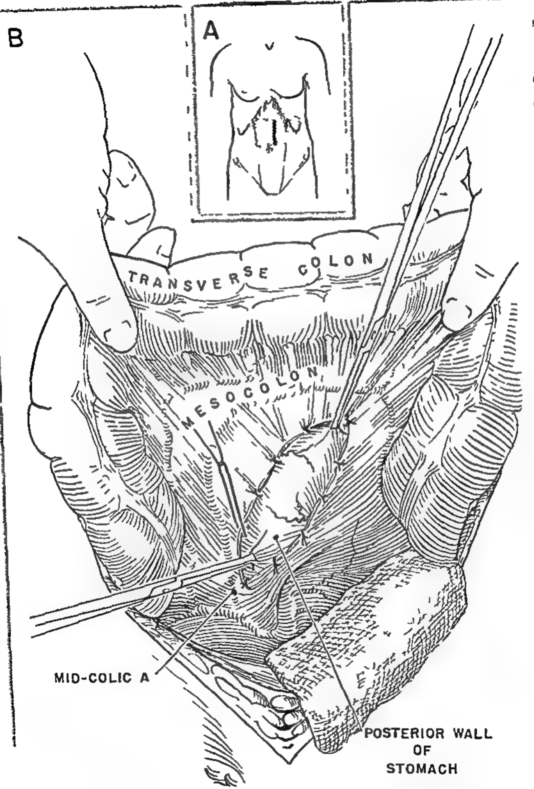
Posterior gastroenterostomy may be used for (1) obstructing duodenal ulcer in which the obstruction is due to cicatrix or (2) as a concomitant procedure with vagotomy It is not recommended *for active duodenal ulcer even in elderly patients and it must* be remembered that many patients with dilated stomachs and low secretion of hydrochloric acid regain acidity with relief of obstruction The operation is not recommended for the severely penetrating posterior wall ulcer that is nonresectable unless vagotomy is added It is not recommended for inoperable cancer of the stomach duodenum or pancreas a long loop anterior gastroenterostomy and enteroanastomosis will function longer

If a posterior gastroenterostomy is to be made a short loop anastomosis with an oblique stoma placed with the afferent jejunum at the lesser curvature and the efferent at the greater curvature is preferred

A—The abdomen is opened through a left paramedian incision (Plate 6) Local anesthesia is adequate if the patient is in poor condition

B—The transverse colon is elevated demonstrating the vessels in the mesocolon An incision 3 in long is then made through the mesocolon just to the left of the midcolic artery The posterior wall of the stomach is then seen with the vessels of the greater curvature visible at the upper left Allis forceps are applied withdrawing a portion of the stomach The stomach is now sutured to the mesocolon

[Postcolic gastroenterostomy *continued on page 138*]

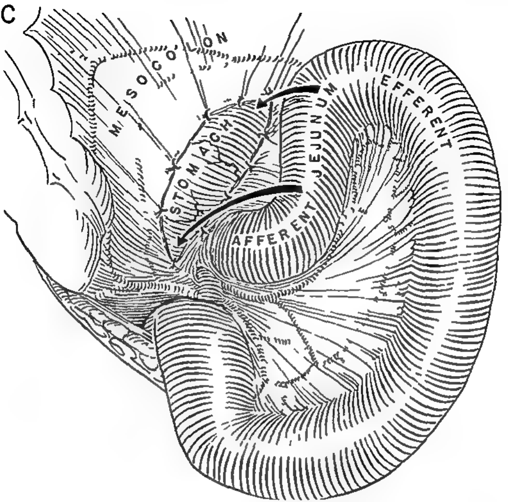

B
A
TRANSVERSE COLON
MESOCOLON
MID-COLIC A
POSTERIOR WALL OF STOMACH

C—The jejunum is identified as it emerges from behind the ligament of Treitz The afferent jejunum is to be sutured near the lesser curvature which is now the most dependent portion of the stomach visible The afferent jejunal loop must be just long enough to lie comfortably when the stomach resumes its normal position A long afferent loop often leads to stasis and postoperative vomiting Usually the distance from the ligament of Treitz to the anastomosis will be about 5 cm although it may be greater if the stomach lies low in the abdomen The operative field is now thoroughly walled off with gauze packs laid on either side of the projected anastomosis and a sponge placed posteriorly between stomach and jejunum

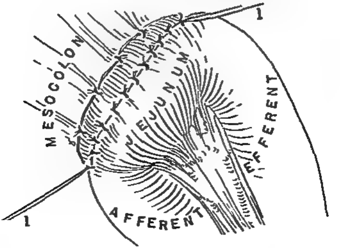
D—The jejunum is sutured to the posterior wall of the stomach by a row of interrupted #40 cotton or #8 silk sutures (*1*) Since the anastomosis is to lie exactly on the antimesenteric margin of the jejunum this row of sutures must be placed about 1 cm away from this line on the posterior wall of the jejunum The sutures are of the Lembert type and are placed at 4 mm intervals The stoma is to be about 6 cm long if the stomach is of normal size If there is excessive gastric dilatation the stoma should be longer

[Postcolic gastroenterostomy *continued on page 140*]

C


MESOCOLON
STOMACH
JEJUNUM
EFFERENT
AFFERENT

D


1
MESOCOLON
JEJUNUM
EFFERENT
AFFERENT
1

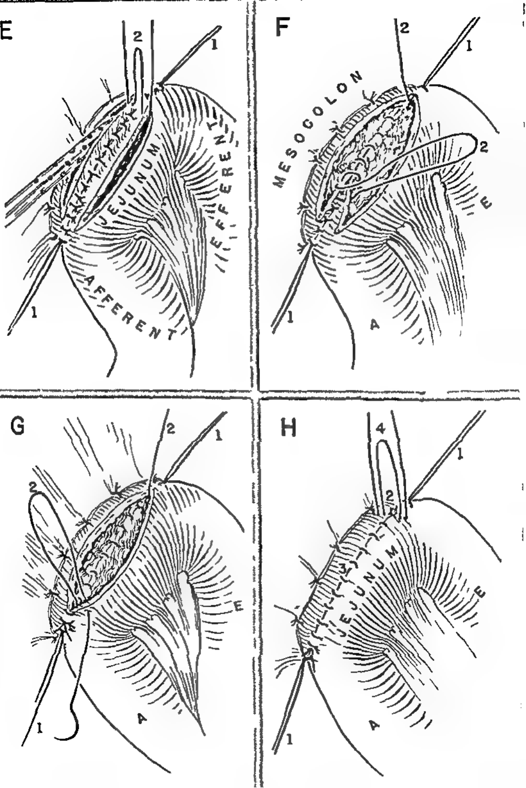
E.—It formerly was the custom to apply thin rubber covered steel clamps to the stomach and jejunum before they were opened. This now is seldom necessary since the stomach is kept empty by means of the Levin tube. The jejunum is first opened exactly on the antimesenteric margin for a distance of 5 cm. Any mucosal bleeders are caught with fine hemostats and ligated with 000 plain catgut. The stomach is then opened for a similar distance, a sucker used to aspirate any gastric residual and any bleeding vessels ligated. The posterior inner row of continuous 000 chromic catgut on a nontraumatic needle is now inserted (2). Either curved or straight needles may be used, depending on the surgeon's preference.

F.—The posterior inner row is continued as a running suture from the upper angle down to the lower. When the lower angle is reached the suture is locked.

G.—The suture is now continued around the lower angle, using a running Connell suture that will invert the mucosa as it progresses.

H.—The anterior inner suture (3) has been run back to the upper angle and tied to the end of the posterior inner suture. The anterior outer row (4) of interrupted cotton or silk is being placed.

[Postcolic gastroenterostomy *continued on page 142*.]


E
2
1
JEJUNUM
EFFERENT
AFFERENT
1
F
2
1
MESOCOLON
2
E
1
A
G
2
1
2
E
1
A
H
4
1
2
3
JEJUNUM
E
1
A

I —The anastomosis has been completed Two additional sutures (*5*) are placed at either end of the suture line to prevent kinking at the stoma

J —The position of the stoma is shown diagrammatically

Several alternative methods may be used The use of clamps has already been mentioned Another variation involves the use of three layers of sutures anteriorly and posteriorly The inner layer approximates mucosa only whereas the outer two layers unite the seromuscular coats of stomach and jejunum The use of three layers on the gastric wall is unnecessary and may increase the incidence of stomal obstruction

Since the weak spot of any anastomosis is at the angles some surgeons hesitate to tie the inner suture exactly at the angle This can be avoided by the method shown in *K–M* a method applicable to any type of gastrointestinal anastomosis

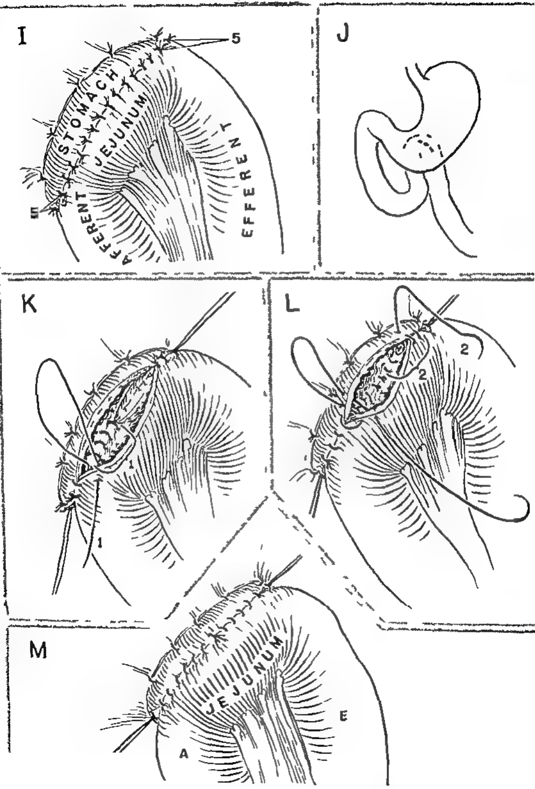
K —The outer posterior line of sutures has been placed The inner posterior row has been started at the midportion of the posterior aspect of the stoma the suture (*1*) carried down around the lower angle and locked

L —A second inner posterior suture (*2*) is now started just above the previous suture and carried up the posterior wall and locked at the upper angle Both sutures are now carried back to the midportion of the stoma along the anterior margin

M —The sutures are then tied together completing the anterior inner row The anterior outer row is then made in the usual way

Complications —The complications of this operation have been discussed briefly However it is wise to re emphasize the dangers of postoperative stomal obstruction particularly in elderly debilitated patients with long standing obstruction and gastric atony Double jejunostomy (Plate 70) performed at the time of operation may be lifesaving in this group of patients

PLATE 36



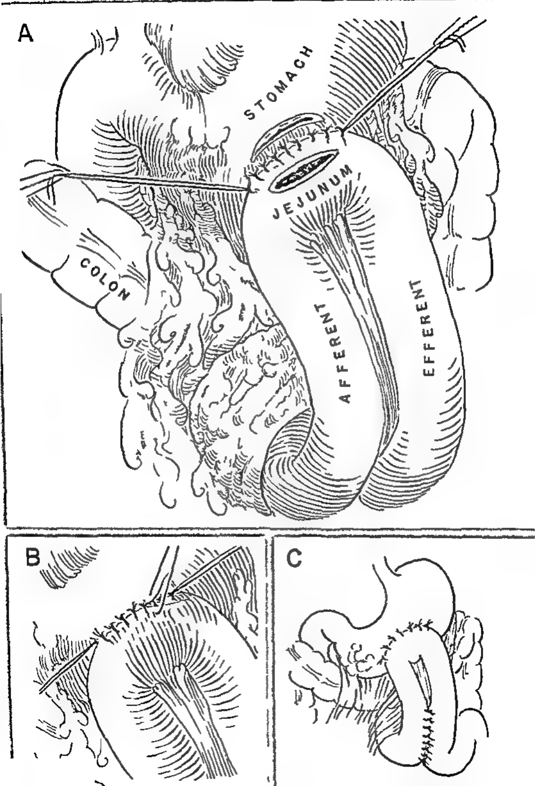
An *antecolic gastroenterostomy is* done *chiefly* for inoperable cancer of the pyloric portion of the stomach duodenum or head of the pancreas It can be used occasionally to relieve stomal obstruction after gastric resection but is not sure to be successful since the same factors that produced obstruction after the first operation may be present in the second It will most probably succeed when some actual organic cause for the obstruction can be demonstrated Though this procedure has been recommended in selected cases of nonresectable duodenal ulcer a first stage gastrectomy (Plate 46) is a better operation

A—Since the operation is usually performed for extensive cancer the stoma must be placed whenever possible as far from the tumor as it can be made Theoretically the best location would be close to the greater curvature with the stoma in a transverse direction *A relatively long loop of jejunum is necessary In this figure the outer* posterior row of sutures has been placed and the stomach and duodenum opened

B—The anastomosis is being completed having been done in the manner illustrated in Plate 36 Additional sutures are placed just lateral to both ends of the anastomosis to prevent kinking

C—The gastroenterostomy is supplemented by an enteroanastomosis between the afferent and efferent loops of jejunum when the operation is done for cancer The enteroanastomosis will prevent regurgitant vomiting from a distended proximal loop as well as any postoperative stomal obstruction This precaution is advisable because emptying of the stomach rarely is as complete after anterior as after posterior gastroenterostomy

PLATE 37



[146] *Gastroduodenostomy*

This simple side to side anastomosis of the stomach and duode num accomplishes the same ends as the various pyloroplasties

A —The duodenum and distal stomach have been mobilized so that the greater curvature may be apposed to the anterior surface of the duodenum They are united by the outer posterior row of inter rupted sutures which is started at the pylorus and run downward for about 5 cm

B —The anterior walls of stomach and duodenum are opened along the lines shown but the incision is not carried through the pylorus as in the Finney pyloroplasty (Plate 33)

C —The posterior inner row is of continuous 000 catgut At the lower angle it is locked and then continued back as a Connell suture to the upper angle where it is tied

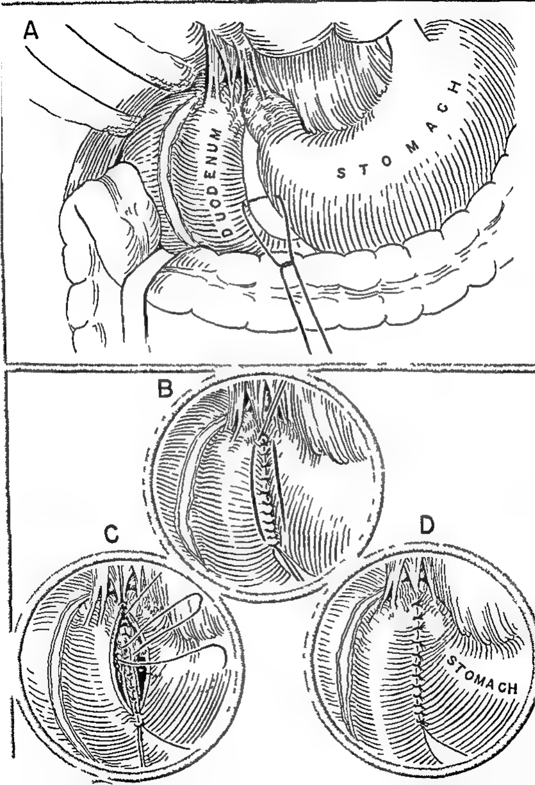
D —The anterior outer row has been placed and tied

It should be noted that mechanical difficulties often arise from this anastomosis Angulation of the duodenum especially if that or gan is of small diameter may lead to early stomal malfunction or later attacks of vomiting Particular care must be taken in the early post operative course to keep the stomach deflated

This operation was regarded very favorably by some of the older surgeons including Jaboulay Wilkie and Finney Although theoreti cally it is a good operation to relieve simple pyloric obstruction later reactivation of an ulcer is not uncommon and any type of secondary resection is made difficult by the gastroduodenostomy For these reasons the operation is used rarely today

A somewhat similar operation is the end to side gastroduodenos tomy that is sometimes carried out after gastric resection It has the advantage that a definitive procedure to prevent further ulcers is car ried out at the same time For technical reasons this procedure is not done frequently but the method is described briefly in Plate 43 *B*

REFERENCE **Jaboulay**


A
DUODENUM
STOMACH
B
C
D
STOMACH

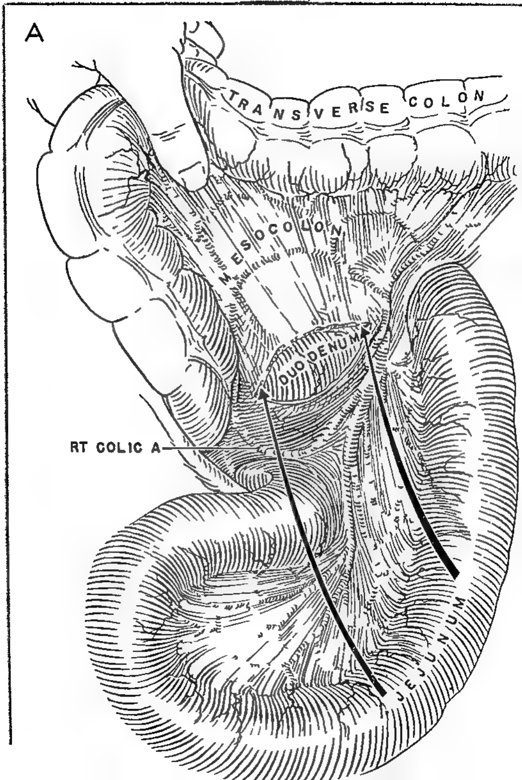
The operation of duodenojejunostomy is done for so called chronic duodenal ileus due to obstruction at the ligament of Treitz Under unusual circumstances the obstruction may be due to definite or ganic causes such as tumor inflammatory adhesions or foreign bodies which can be relieved by appropriate measures Usually however no actual cause can be found to account for the obstruction, and it is assumed to be due to pressure on the duodenum from the superior mesenteric vessels A congenital absence of nerve supply is probable in some cases and megaduodenum appears to be similar in many respects to megacolon

Duodenojejunostomy as illustrated here should be done only in the small group of patients in whom there is (1) no dilatation of the intestine beyond the ligament of Treitz (2) failure to respond to an adequate trial of medical therapy comprising a bland diet antispas modics and rest in bed after meals with elevation of the foot of the bed and (3) at operation no demonstrable cause for obstruction other than compression from the superior mesenteric vessels

A—The abdomen has been opened through a right paramedian incision Exploration has shown a greatly distended duodenum and a normal jejunum On elevation of the transverse colon the large third portion of the duodenum may be observed bulging through the mesocolon The middle colic and right colic arteries must be iden tified The mesocolon is then opened between them exposing the duodenum

[Duodenojejunostomy *continued on page 150*]

PLATE 39



B —The duodenum has been mobilized widely enough to obtain an anastomosis that will be 5 cm long The jejunal loop will be about 15 cm from the ligament of Treitz—one as short as possible yet avoid ing any kinks or tension Before starting the anastomosis the inferior margin of the duodenum must be sutured to the mesocolon with interrupted sutures *at least 2 cm posterior to the projected* anasto mosis The usual two layer anastomosis is to be carried out with an outer layer of nonabsorbable sutures and an inner layer of 000 chromic catgut on a nontraumatic needle In this figure the outer posterior row has been completed It should be noted that as the duodenal distention is relieved after operation the length of the anastomosis will diminish Consequently it should be of generous size

C —The remainder of the procedure in the formation of the anas tomosis is exactly the same as that illustrated for gastroenterostomy (Plate 36) and therefore will not be repeated in detail

In this sketch, the duodenum and jejunum have been opened by incisions parallel to and 1 cm from the outer posterior row The inner posterior row of continuous 000 chromic catgut has been in serted locked at the lower angle and carried back as the inner an terior row with a Connell suture

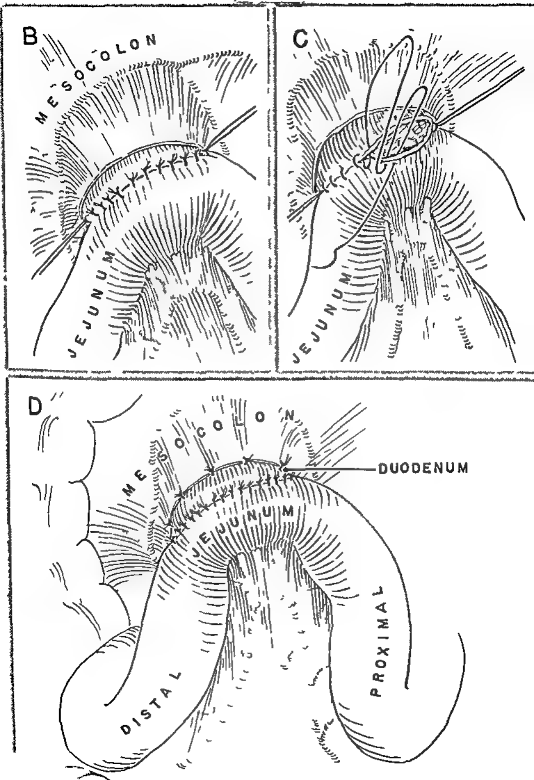
D —The anastomosis has been completed by an outer anterior row of interrupted cotton or silk The hiatus in the mesocolon is then obliterated by a series of sutures that unite the upper *leaf of the* mesocolon to the duodenum Before the abdomen is closed the sur geon must be sure there is no kinking of the proximal loop of the jejunum

The reported results of operation vary considerably In this coun try the operation does not enjoy great popularity but when done only for strict indications the results have been excellent If attempts are made to relieve thin neurotic women with ptosis of the stomach duodenum and colon by this operation only failure can be expected

Anastomosis of the jejunum to the duodenum above the level of the ampulla of Vater (Plate 14 *L*) is indicated for certain congenital abnormalities such as duodenal stenosis and annular pancreas in infancy

REFERENCES Maingot Eusterman and Balfour

PLATE 39


B
MESOCOLON
JEJUNUM
C
JEJUNUM
D
MESOCOLON
DUODENUM
JEJUNUM
DISTAL
PROXIMAL

SECTION 14

Duodenal and Gastric Ulcer

Choice of Operation

Duodenal ulcer.—Duodenal ulcer is a disease treated primarily by medical measures. Surgery is indicated for its various complications, namely, acute perforation, hemorrhage, obstruction and intractability. Simple suture usually is done for perforations, whereas other complications demand some type of gastric resection or, less commonly, gastroenterostomy or vagotomy. The management of acute perforation and of acute massive hemorrhage will be considered later. In this section the choice of operation for patients with hemorrhage in the interval period, with obstruction or with an intractable ulcer will be discussed.

Of the numerous operations which have been done for duodenal ulcer, several are now only of historical importance; these include local excision, pyloroplasty and gastroduodenostomy. At present the accepted procedures are gastric resection, gastroenterostomy and vagotomy combined with some ancillary procedure. Wangensteen believes that segmental resection is a highly satisfactory operation.

Gastric resection is the operation that is most certain to achieve a satisfactory end result. Removal of the entire antral mucosa and of approximately 75 per cent of the stomach is necessary. Unless the operation is done for acute hemorrhage, the duodenal ulcer itself does not need to be included in the resection if its removal would be technically difficult, because the dangers following mobilization more than counterbalance the chances of perforation or hemorrhage from the retained ulcer in the early postoperative period. The end result is the same provided no antral mucosa remains.

The type of resection depends on the appraisal of the inflam

matory reaction in and around the duodenum and on the technical ability of the surgeon Even in the most skilful hands it is difficult to make the line of section distal to the pylorus in at least 5 per cent of cases and when the surgeon has less experience the percentage of nonresectable ulcers rises appreciably

Gastrointestinal continuity after resection must be re established by some type of gastroenterostomy It is often difficult to use the duodenum with a Billroth I anastomosis because of the relatively fixed duodenum and high gastric resection Nor are the end results after Billroth I resections for duodenal ulcer as good as those after a Billroth II

There is no complete agreement among surgeons concerning the best type of gastrojejunostomy to be employed with Billroth II operations It is generally accepted that closure of the upper portion of the remnant of stomach (Hofmeister) is preferable to use of the entire cut end (Polya) since the gastrojejunostomy can be done at a lower and more accessible level The tendency at present is to prefer short rather than long anastomotic loops in the belief that the incidence of the dumping syndrome will be reduced The relation between size of stoma and this syndrome has never been completely clarified

The anastomosis may be placed either anterior or posterior to the colon Antecolic anastomoses are technically easier to make and are more simple to expose if an anastomotic ulcer develops Theoretically they should be subject to a higher incidence of hernias about the anastomosis although in practice such hernias are rarely observed If short afferent loops are used the incidence of recurrent ulcer or of postgastrectomy symptoms apparently does not vary whether the anastomosis is ante or postcolic

The selection of operation is made on the following bases

Gastroenterostomy alone is a poor operation It is indicated chiefly in elderly patients with cicatricial obstruction and a low gastric acidity Unfortunately even in this group gastric acidity often rises after obstruction is relieved and reactivation of the ulcer or an anastomotic ulcer results Hence this operation is used rarely

Though *gastric resection* has in the author s experience been a more satisfactory operation than vagotomy combined with ancillary procedures it is certain that there are many surgeons who hold the opposite opinion and in any event the difference in the two competing methods is not great For this reason if gastric resection appar

ently will be too hazardous vagotomy with antral exclusion or gastroenterostomy is wisest unless the operation is for acute massive hemorrhage In this event the dangers of resection must be accepted in order to control bleeding

The following procedures are advised in descending order of preference

1 Gastric resection (75 per cent) with division of the duodenum distal to the ulcer Slightly less stomach is removed in females and in patients with greatly distended stomachs An antecolic Hofmeister anastomosis is used when the mesocolon is short or thick or when secondary operations on the stomach are done in other cases either an ante or postcolic anastomosis may be made Vagotomy is added if preoperative gastric acidity or the volume of night secretion is high

2 Gastric resection with division of the duodenum proximal to the ulcer

3 Gastric resection (50 per cent) with vagotomy is indicated in thin males and in many females in whom it is desirable to minimize postoperative weight loss

4 Antral exclusion with vagotomy This method is employed if the ulcer apparently cannot be resected easily Vagotomy combined with gastroenterostomy or with pyloroplasty at present seems somewhat less satisfactory

5 Gastric resection with duodenostomy (Plate 53) This operation is reserved for the rare cases in which the duodenum must be opened or has been opened and adequate closure would be extremely difficult

6 Two stage gastric resection (Plates 46 and 47) This is the safest operation when the ulcer cannot be resected easily and when vagotomy is for some reason impossible However in nearly all instances a vagotomy combined with the first stage of the operation makes an acceptable procedure and the second stage will not be necessary

7 Gastric resection with division of the distal stomach through the antrum and excision of the antral mucosa (Bancroft operation Plate 48) This is often a difficult and dangerous technical procedure

Gastric ulcer—In contrast with duodenal ulcer gastric ulcer is primarily a surgical disease Treated medically the rate of healing

often is extremely slow and recurrence is common The complications of acute perforation and hemorrhage are more likely to be fatal with gastric than with duodenal ulcer But of greater importance is the fact that approximately 10 per cent of apparently benign ulcers of the stomach actually are cancer Medical treatment therefore is reserved for about 25 per cent of patients with gastric ulcers It is indicated only in young patients and the ulcer must be acute and small and on the lesser curvature there must be free acid in the stomach and the ulcer must heal promptly under treatment and remain healed thereafter on repeated follow up examinations Other patients unless complicating disease or age contraindicates it have surgery

The surgical procedure should be designed as a cancer operation when *the ulcer is in the distal stomach (Plates 59 and 60) This* means that a partial resection of the distal stomach including the regional lymph nodes will be necessary Vagotomy and gastroenterostomy are contraindicated

The great majority of benign gastric ulcers can be removed by subtotal distal resection Whenever possible a margin of 5 cm of normal stomach is obtained above the ulcer When the ulcer is higher in the stomach the margin of normal stomach may be shaded (see Plate 59 *Q*) In general terms total gastrectomy is undesirable for a benign ulcer though some ulcers are so large they can be removed in no other way

There are a few ulcers in the cardia or near the esophagus that furnish a most difficult problem A proximal gastric resection carried out by the transthoracic approach has been a satisfactory procedure in the Massachusetts General Hospital An alternative procedure is the Madlener operation (Plate 59 *R*) in which the ulcer is not removed but a subtotal distal resection is carried out This operation should not be done unless the presence of cancer has been essentially ruled out by intragastric biopsy of the lesion

REFERENCES Allen and Welch Mayo Trimble and Lynn

There are so many advantages of the transabdominal approach to the vagus nerves that this method has now almost entirely supplanted the transthoracic operation Associated procedures upon the stomach can be carried out much more easily Other abdominal viscera can be examined The vagus trunks are more likely to be single at the terminus in the gastric wall just distal to the esophageal hiatus than at any other point

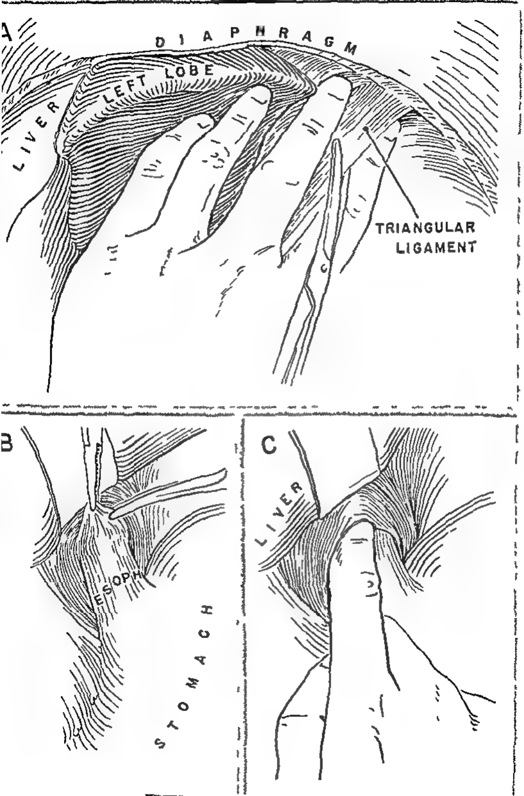
A—A left upper paramedian incision (Plate 6) extending nearly to the xiphoid has been made It is now necessary to expose the esophageal hiatus which is overlapped by the left lobe of the liver To mobilize the left lobe the surgeon places traction on the triangular ligament by *grasping it between the index and middle* fingers of the left hand With the scissors the ligament may be divided for a distance of 3 or 4 in The division is made a short distance away from the diaphragm to avoid branches of the inferior phrenic vessels which can be seen lying near the origin of the ligament Thereafter the tip of the left lobe is turned down covered with a gauze pack and held away by gentle traction on a Deaver retractor

B—With the right index finger it is now easy to identify the esophageal hiatus The thin layer of peritoneum covering the esophagus is then elevated with a forceps and opened with scissors This incision must not be carried deep enough to injure the esophagus

C—The peritoneum has been opened for a distance of about 1 in The vertical fibers of the esophagus are exposed thereby The tip of the right index finger is then inserted along the esophagus By gentle dissection passing the finger entirely around the esophagus and well above the hiatus it is possible to mobilize the distal 2 in of esophagus

[Transabdominal vagotomy *continued on page 158*]

PLATE 40


A
DIAPHRAGM
LIVER
LEFT LOBE
TRIANGULAR LIGAMENT
B
ESOPH
STOMACH
C
LIVER

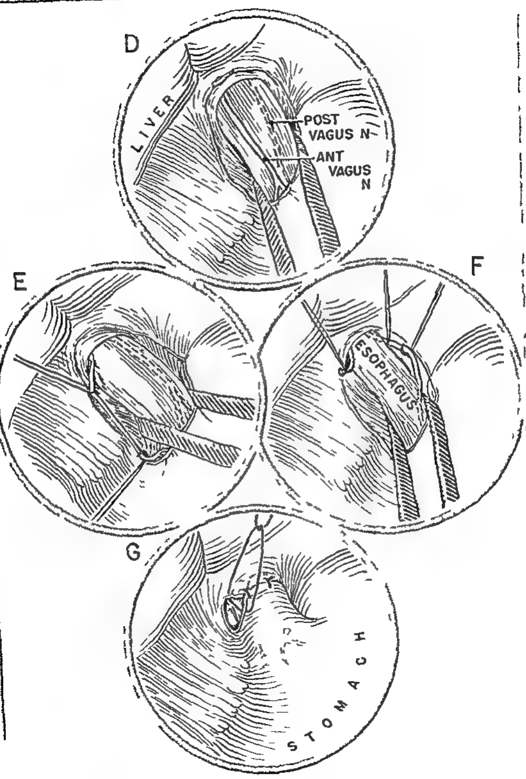
There are so many advantages of the transabdominal approach to the vagus nerves that this method has now almost entirely supplanted the transthoracic operation. Associated procedures upon the stomach can be carried out much more easily. Other abdominal viscera can be examined. The vagus trunks are more likely to be single at the terminus in the gastric wall just distal to the esophageal hiatus than at any other point.

A.—A left upper paramedian incision (Plate 6) extending nearly to the xiphoid has been made. It is now necessary to expose the esophageal hiatus which is overlapped by the left lobe of the liver. To mobilize the left lobe, the surgeon places traction on the triangular ligament by grasping it between the index and middle fingers of the left hand. With the scissors, the ligament may be divided for a distance of 3 or 4 in. The division is made a short distance away from the diaphragm to avoid branches of the inferior phrenic vessels which can be seen lying near the origin of the ligament. Thereafter, the tip of the left lobe is turned down, covered with a gauze pack and held away by gentle traction on a Deaver retractor.

B.—With the right index finger, it is now easy to identify the esophageal hiatus. The thin layer of peritoneum covering the esophagus is then elevated with a forceps and opened with scissors. This incision must not be carried deep enough to injure the esophagus.

C.—The peritoneum has been opened for a distance of about 1 in. The vertical fibers of the esophagus are exposed thereby. The tip of the right index finger is then inserted along the esophagus. By gentle dissection, passing the finger entirely around the esophagus and well above the hiatus, it is possible to mobilize the distal 2 in. of esophagus.

[Transabdominal vagotomy continued on page 158.]


D
LIVER
POST
VAGUS N
ANT
VAGUS
N
E
F
ESOPHAGUS
G
STOMACH

D —Gentle traction on the esophagus will allow almost 2 in to be withdrawn below the hiatus Meanwhile the vagus nerves are palpated as taut cordlike structures There is usually only one trunk for each nerve at this level The anterior nerve is usually slightly to the right and the posterior to the left

E —After the nerves have been palpated they are elevated individually on nerve hooks The upper ends of the nerve are ligated with silk or compressed with silver clips at as high a level as possible In this figure the anterior nerve has been dissected first

F —A section of nerve about 4 cm long including the entire distal nerve down to the point where the terminal branches disappear into the gastric wall has been removed The same procedure is then carried out on the opposite nerve Finally a careful search is made of the entire hiatus and esophagus removing any structures that resemble nerve fibers

G —The peritoneum overlying the esophagus may be closed with fine silk sutures

It may be well to point out several precautions

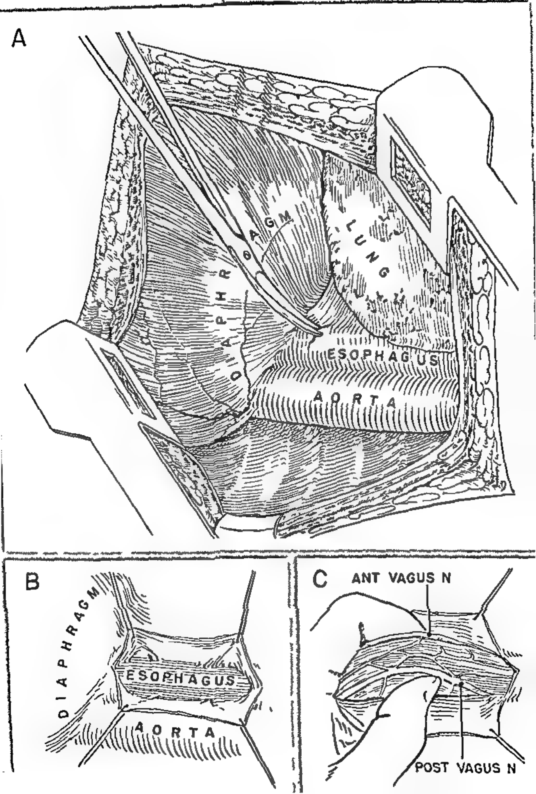
1 If any vagal fibers are left the operation is useless Make a careful search for all fibers Variations from the normal will be found in nearly one fourth of the cases

2 The esophagus must be handled with great consideration Traumatic perforation unless detected and repaired will lead to mediastinitis and death

3 Under certain circumstances mobilization of the esophagus may produce a pneumothorax Intratracheal ether anesthesia therefore is best Frequent examination of the chest is necessary after operation and catheter drainage of the pleural cavity a wise precaution

4 Postoperatively disturbances of gastric motility are common For this reason a concomitant procedure on the stomach must be done to promote drainage This may be a gastric resection gastroenterostomy or pyloroplasty Postoperatively the stomach may need decompression for a protracted period Farris suggestion of a Foley catheter gastrostomy may be followed

PLATE 41


A
DIAPHRAGM
LUNG
ESOPHAGUS
AORTA
B
DIAPHRAGM
ESOPHAGUS
AORTA
C
ANT VAGUS N
POST VAGUS N

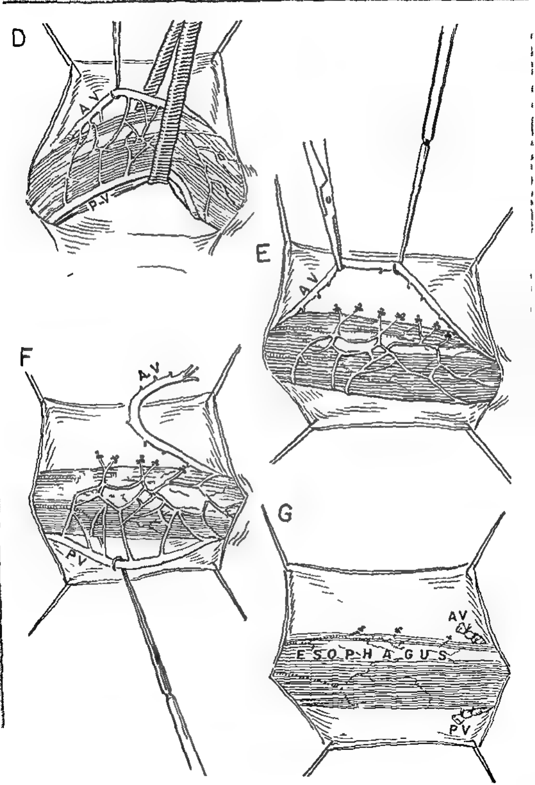
A.—The left chest has been opened through the bed of the resected eighth or ninth rib (Plate 10) The lower lobe of the lung is retracted and the pulmonary ligament is developed sufficiently to expose the esophagus Usually it is unnecessary to cut the ligament if this is done a vein in the ligament just anterior to the esophagus should be identified and doubly ligated before it is sectioned

B.—The mediastinal pleura overlying the esophagus has been opened just lateral to the pulmonary ligament from the diaphragm cephalad for a distance of at least 8 cm Traction sutures have been applied to aid exposure

C.—By blunt dissection about 5 cm above the diaphragm the left index finger is now passed about the esophagus gently elevating it from its bed Simultaneously the vagus nerves are palpated as taut cords each about the diameter of the lead in a pencil either on or immediately adjacent to the esophagus It is usually best to identify the nerves by palpation and then to visualize them as the esophagus is lifted by the fingers The anterior nerve courses down the right anterior wall of the esophagus and the posterior down the left posterior wall Any other structures that palpably suggest nerve trunks should also be isolated and investigated carefully It is well to note that the thoracic duct lies posterior to the esophagus and slightly to the right at this level it is possible to damage it during a vagotomy unless care is taken The Levin tube which is inserted into the stomach before operation will be palpated easily as the esophagus is elevated

[Transthoracic vagotomy *continued on page 162*]

PLATE 41



D—A traction tape has been passed about the esophagus and vagus nerves to aid in their identification During this mobilization of the esophagus a few segmental arterial vessels will be encountered running from the aorta to the posterior wall of the esophagus It is best to control them before they are cut Hemostasis by silver dural clips is simple and satisfactory and is preferable to individual ligation of bleeders The anterior nerve (*AV*) is to be dissected first and it is now elevated with a nerve hook

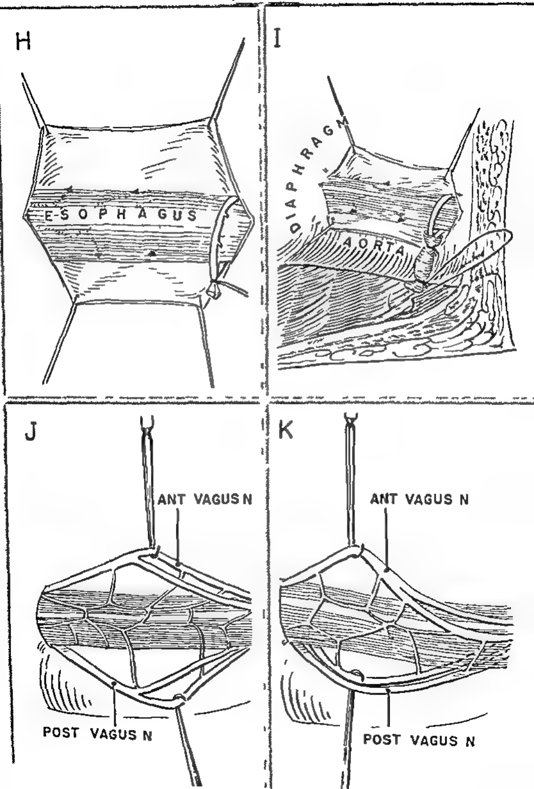
E—As the nerve is elevated filaments may be seen crossing the esophagus to join with the opposite nerve These are all to be removed later In addition blood vessels accompany the nerve and as the nerve is freed must be controlled with clips The nerve is then pulled cephalad strongly By dissection with a long pair of Hartmann forceps the nerve can be pulled upward so that 1–2 cm of the subdiaphragmatic portion is exposed Below the diaphragm the nerve decussates into the terminal branches that enter the gastric wall At this point clips are applied distally and the nerve divided

F—The nerve has now been mobilized for a distance of about 6–7 cm If the dissection is carried higher there may be an excessive amount of cardiospasm in the early postoperative period The posterior nerve (*PV*) is now elevated on a hook and the same procedure carried out

G—The proximal ends of the nerves have been ligated with silk The remaining vagal fibers lying about the lower 3 in of esophagus have been removed

[Transthoracic vagotomy *continued on page 164*]

PLATE 41


H
ESOPHAGUS
I
DIAPHRAGM
AORTA
J
ANT VAGUS N
POST VAGUS N
K
ANT VAGUS N
POST VAGUS N

H —As an alternative method to prevent regeneration Moore has suggested that the proximal nerve ends be enclosed in a silk cylinder The proximal ends of the nerves are left somewhat longer since the anterior nerve must cross the esophagus The nerve ends are tied together with silk The ligature is not cut

I —A silk cylinder has been slipped over the ligatures and nerve ends The cylinder is tied about the nerve ends and then anchored to the pleura lateral to the esophagus

Although this method was often used in the Massachusetts General Hospital it has never been demonstrated that there is regeneration of the cut vagi or that this method could prevent it. However in upper dorsal sympathectomies where regeneration is common Smithwick the originator of the method believes it is of great value

Anatomical variations of the vagus nerve are common Generally speaking in about 75 per cent of cases the anatomy will be similar to that previously described In most of the rest one or both trunks are double In a few instances only a plexus is encountered with no discrete trunks Two common variations are shown in *J* and *K*

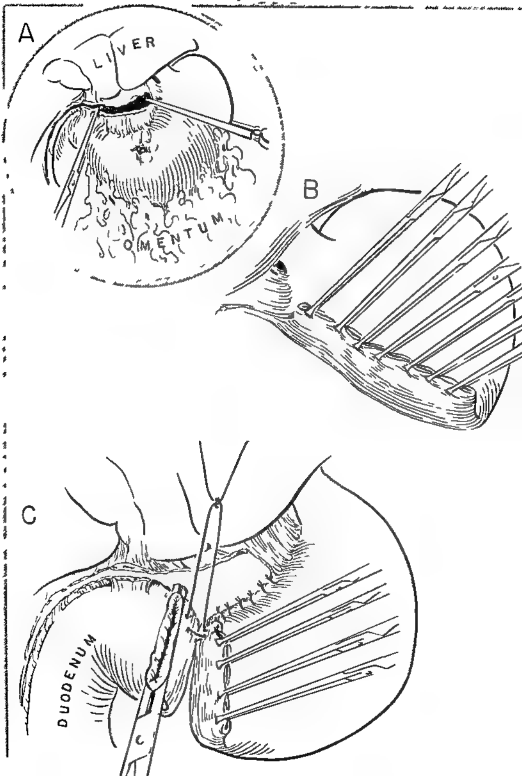
J —The upper portions of both trunks are double but unite to form a single trunk a short distance above the diaphragm

K —A single anterior trunk and a double posterior trunk extend through the esophageal hiatus

It appears that variations from normal are least common at the level of the esophageal hiatus and it is at this point that single trunks are most likely to be found However abnormalities occur so often that careful exploration is necessary in all cases in order to produce a complete vagotomy

REFERENCE Moore

PLATE 42



 Billroth I Operation

The Billroth I operation refers to a gastric resection followed by some form of anastomosis to the duodenum The usual type of anastomosis will be illustrated in this series of figures and some variations shown in Plate 43 With this type of procedure the gastro intestinal tract is reconstituted in a more normal fashion than with a Billroth II operation and consequently fewer postresection symptoms should result However applicability of the Billroth I is limited since the duodenum must be freely movable and sufficient stomach must be left to allow an anastomosis without tension It may be used for duodenal ulcer or gastric cancer but it is indicated particularly for benign gastric ulcer or spindle cell and benign tumors of the distal stomach When nonrotation of the small intestine is present and the jejunum descends directly down from the duodenum on the right side of the abdomen a Billroth I is an excellent operation

Recently stimulated particularly by Harkins enthusiasm there has been a revival of interest in this operation for duodenal ulcer He believes that an adequate amount of stomach can be removed and an anastomosis accomplished by this method

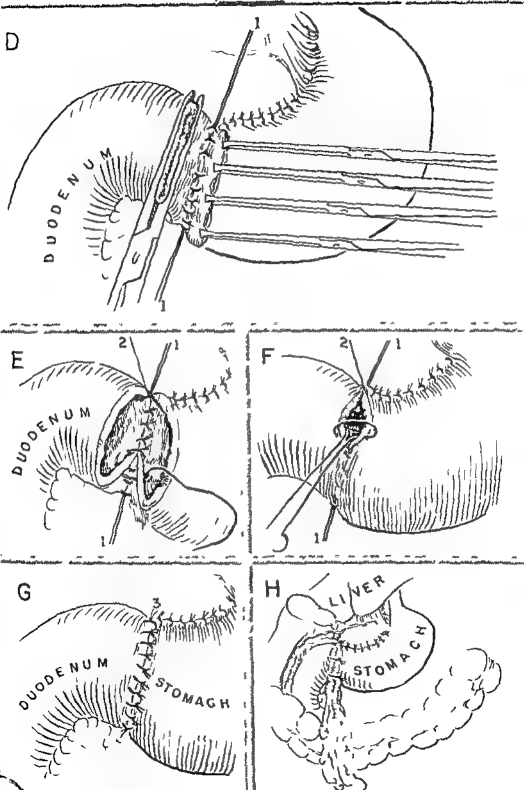
A —A Billroth I is being done for a benign gastric ulcer The distal half of the stomach has been mobilized It must be emphasized again that if the resection is done for duodenal ulcer 75 per cent of the stomach must be removed or a vagotomy added The duodenum will be divided just distal to the pylorus with a scalpel between Allen clamps The stomach is divided between Payr clamps Before the distal stomach is removed it is well to free the duodenum from surrounding adhesions and to be sure the greater curvature of the stomach will reach the duodenum without tension An adequate blood supply for the remaining stomach should be furnished by the vasa brevia but at times the terminal portion of the left gastro epiploic artery may be retained with the stomach as well providing additional protection

B —The stomach has been resected the clamp removed and a row of Allis forceps applied to the crushed edge

C —The upper portion of the lesser curvature is now turned in so that the remaining portion of the stomach is the same width as the duodenum Turn in is accomplished by two suture layers the inner of continuous 00 catgut the outer of interrupted silk or cotton

[Billroth I operation *continued on page 168*]

PLATE 42


D
1
DUODENUM
1
E
2
1
DUODENUM
1
F
2
1
1
G
3
DUODENUM
STOMACH
H
LIVER
STOMACH

D—An end to end gastroduodenostomy is now performed The posterior walls of stomach and duodenum are united by a row of interrupted nonabsorbable sutures placed about 1 cm below the open ends The upper and lower sutures are tied left long and put on light traction (*1 1*) the other sutures are tied and cut

E—The clamps have been removed from the stomach and duodenum Any secretions are picked up immediately by a suction tip A 00 nontraumatic catgut suture is then used on the posterior inner row leaving one end long (2) If the duodenum is narrow the inner row of sutures is made entirely of interrupted fine catgut Even if the duodenum is wide it is well to lock this running suture occasionally In all circumstances it should be locked as it rounds the lower corner

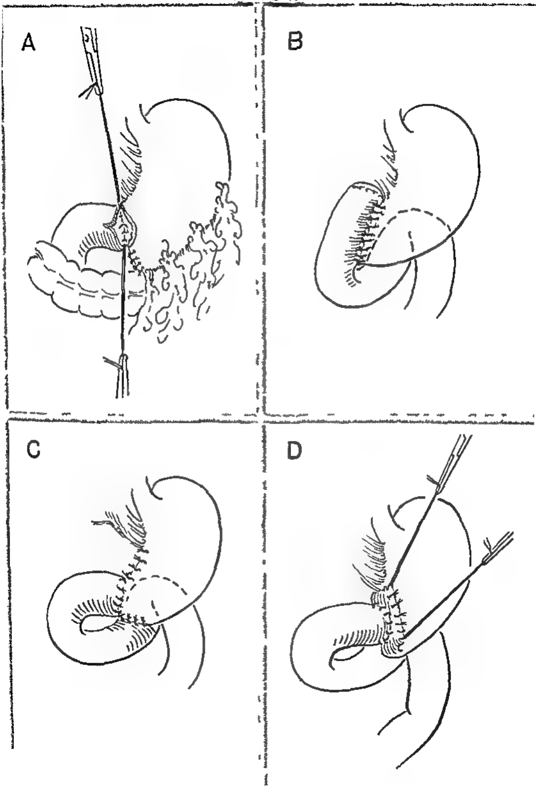
F—The catgut suture is then continued onward to form the anterior inner row Again interrupted sutures are preferred although with a wide duodenum a Connell suture may be used

G—The outer anterior row of interrupted silk or cotton is then placed Particular care must be taken at point *3* since at this spot the suture lines converge It is well to reinforce this junction with an additional suture that catches the duodenum and both walls of the stomach just above the anastomosis

H—The anastomosis has been completed It is well to protect it with separate tags of omentum placed anteriorly and posteriorly and sutured in place At this time the anastomosis should lie freely without tension If there is any tension it may be reduced by any of several maneuvers Further mobilization of the greater curvature may be secured as previously mentioned in *A* The lateral margin of the duodenum may be mobilized as shown in the sketch If tension still exists the greater curvature should be pulled to the right by anchoring sutures that run from it to the round ligament If these sutures are necessary they should be placed well away from the anastomosis

REFERENCE Harkins

PLATE 43



Several modifications of the Billroth I operation have been devised by various surgeons Four methods that are described most frequently will be illustrated They are included chiefly because of their historical importance

A Horsley s method —The gastric resection is completed leaving the lesser curvature relatively long The width of the duodenum is increased by a short horizontal incision on the midportion of the anterior wall The open ends of stomach and duodenum are then equalized by closing the lower portion of the greater curvature

B Finney anastomosis —In this operation an end to side gastroduodenostomy is made This requires rather wide mobilization of the descending duodenum and closure of the upper end The anastomosis must be made on the anterior wall of the duodenum

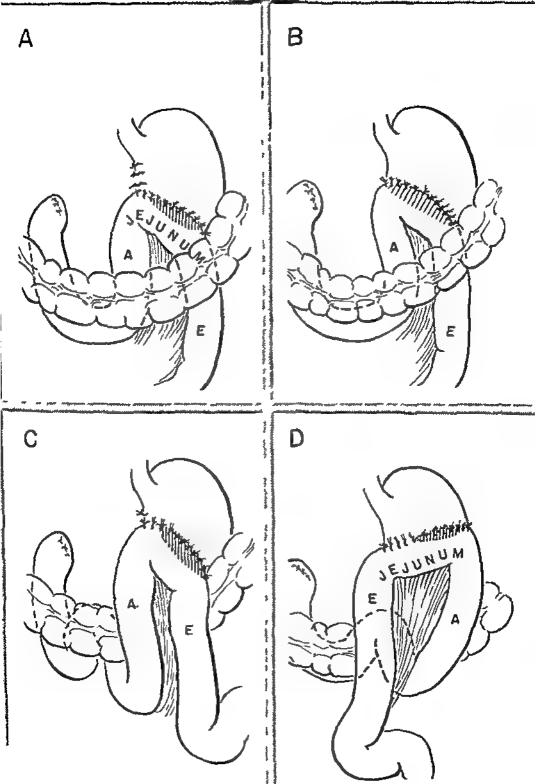
This is also called the von Haberer anastomosis but Dr R R Best has noted that von Haberer discarded this operation almost at the same time he recommended it and preferred the Billroth I anastomosis as shown in Plate 42

C End to end gastroduodenostomy with narrowing of both curvatures —In this procedure two weak angles are produced and the blood supply of the anastomosis is not as good as in the original Billroth I

D Kocher s operation —This is a posterior end to side duodenogastrostomy The cut end of the stomach is closed and the duodenum is implanted through the posterior wall

With all these modifications there is a great temptation to resect too small an amount of stomach When the resection is performed for ulcer extensive removal of the lesser curvature must not be neglected Hence except for the value of Horsley s maneuver to increase the width of the duodenum these modifications are inferior to the original Billroth I procedure

PLATE 44



Resection of the stomach followed by anastomosis of the stomach with the jejunum results in one of the so called Billroth II operations Of the numerous variations those most frequently used are described in *A–D* In the diagrammatic illustrations the stomas are shown by cross hatched areas

A Retrocolic Hofmeister anastomosis —This is probably the most widely used and the best of these anastomoses Although ascribed to Hofmeister it was developed independently by Finsterer This is an end to side gastrojejunostomy in which the upper end of the cut stomach is closed and the anastomosis made between the lower end of the stomach and the jejunum The jejunal loop is brought up behind the transverse colon The afferent loop is short and attached to the lesser curvature

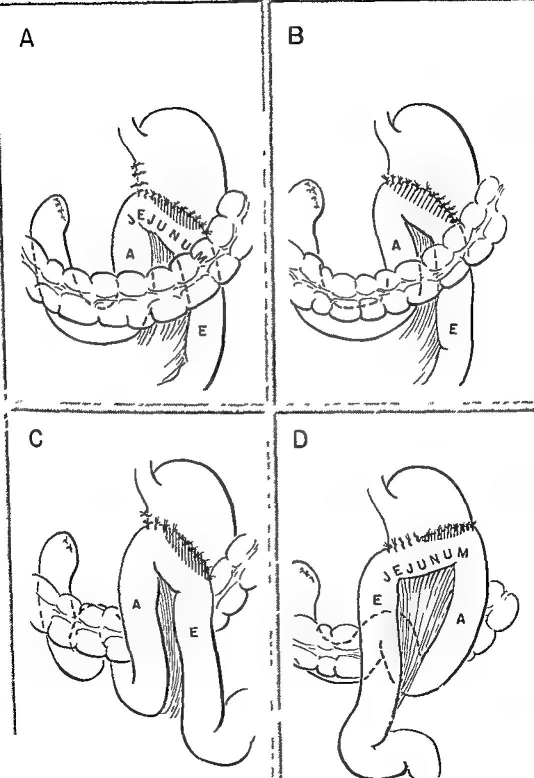
B Retrocolic Polya anastomosis —This differs from the retrocolic Hofmeister in only one detail—the entire cut end of the stomach is used for the anastomosis With high resections there may be tension at the junction of a short afferent jejunal loop and the lesser curvature Technically the Polya is less satisfactory than the Hofmeister and many surgeons believe it is more often associated with post gastrectomy symptoms

C Antecolic anastomoses —In distinction to the retrocolic anastomosis the same procedure may be accomplished with the jejunum brought anterior to the colon Unless the omentum is poorly developed or removed and the transverse mesocolon short a relatively long afferent loop will be required Therefore omentectomy is usually wise When the jejunum is sutured to the entire open end of the stomach afferent loop to lesser curvature a Kronlein (or Balfour) anastomosis is formed If the upper end of the stomach is closed it is often known as an antecolic Hofmeister but actually is a von Eiselsberg anastomosis

D Antecolic anastomosis (Moynihan) —In this anastomosis an afferent loop 4 or 5 in long is attached to the greater curvature Only the lower end of the cut stomach is used for the opening into the jejunum The stomach should be cut across more transversely than with other anastomoses with the greater curvature divided at the same or higher level than the lesser to prevent angulation and obstruction of the afferent loop

[Billroth II modifications *continued on page 174*]

PLATE 44



Less common Billroth II resections are shown in *E-H*

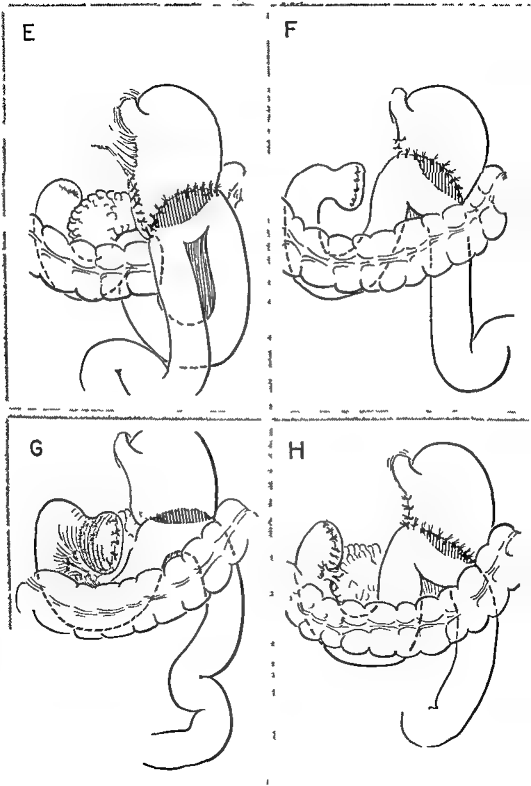
E Original Billroth II—This sketch illustrates the original Billroth II operation and is now of historical interest only In his first gastric resection with gastroenterostomy Billroth planned a two stage procedure The first stage was to be an antecolic gastroenterostomy with the proximal jejunum at the greater curvature At a later date the distal stomach was to be resected

EXCLUSION OPERATIONS —A number of resections remove a portion of the stomach but leave the ulcer or cancer in situ Since these procedures exclude the ulcer from the contents of the proximal stomach they are known as resections for exclusion or exclusion operations

F—This is the simplest of the exclusion procedures and was described first by von Eiselsberg He used it originally for cancer later it was applied by others including Devine to the difficult duodenal ulcers The midportion of the stomach is resected The distal stomach is turned in proximal to the pylorus The jejunum is then anastomosed to the proximal stomach This operation is occasionally helpful with nonresectable cancer of the distal stomach With duodenal ulcer it is a dangerous procedure because the antral mucosa is not removed Consequently if such an operation is necessary for ulcer a vagotomy must be done or the pylorus must be resected at a second stage in six weeks to avoid an anastomotic ulcer A planned two stage operation of this type was advised first by McKittrick Moore and Warren for difficult duodenal ulcers

G—The Bancroft operation differs from the von Eiselsberg procedure in that all gastric mucosa has been removed from the distal gastric segment as far down as the pylorus

H—A resection for exclusion of a low lying duodenal ulcer can also be performed by dividing normal duodenum just beyond the pylorus and effecting a closure proximal to the ulcer In contradistinction to the von Eiselsberg operation this is a perfectly satisfactory procedure for duodenal ulcer unless the operation is done for acute massive hemorrhage


E
F
G
H

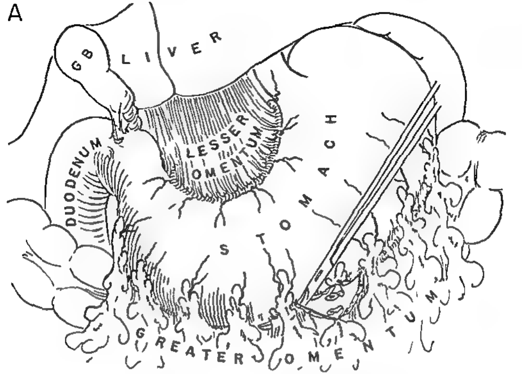
In the Massachusetts General Hospital, the best operation for duodenal ulcer is considered to be gastric resection with removal of not over 75 per cent of the stomach Restoration of continuity by a retrocolic Hofmeister anastomosis will be described in detail in *A–AC* and by an antecolic anastomosis in figures *AD–AF*

A —The abdomen has been opened and explored Particular attention should be given to palpation of the duodenum stomach gallbladder liver and spleen Occasionally enlarged veins about the stomach or esophageal hiatus and an enlarged spleen indicate the presence of portal hypertension An unexpected tumor may be encountered particularly in the gastric fundus that should be removed The presence or absence of gallstones must always be noted and the approximate course of the common duct ascertained Finally and most important the duodenum is palpated carefully and an appraisal made of the difficulties that will be encountered during resection If there is a large inflammatory mass in the head of the pancreas some other type of resection must be considered In the case illustrated there is only moderate fixation to the pancreas and a 75 per cent resection is to be carried out

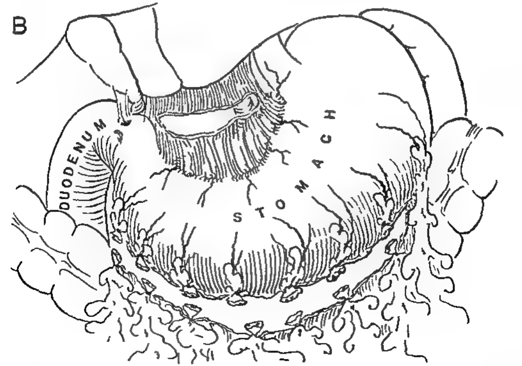
The greater curvature is mobilized first beginning slightly to the left of the midportion of the stomach At this point the individual branches of the gastroepiploic artery are clearly visible they are individually clamped and ligated between artery and stomach The artery is left in situ to nourish the omentum—an important feature when the omentum is large and heavy—or the omentum must be removed As soon as a few vessels have been interrupted the index and middle fingers of the surgeon s left hand can be passed beneath the stomach putting these structures on slight tension and facilitating dissection

B —There is no method by which the amount of stomach to be removed can be estimated with accuracy However if the dissection on the greater curvature is carried to a point about 1 in below the spleen about three fourths of the stomach will be removed This point can be identified by putting traction on the stomach pulling it to the right A tight band the gastrolienal ligament can be palpated running from stomach to spleen at the level of the first of the vasa brevia When this ligament is divided sufficient mobilization is secured

A


GB
LIVER
LESSER OMENTUM
DUODENUM
STOMACH
GREATER OMENTUM

B


DUODENUM
STOMACH

C —The gastrocolic omentum has been freed to the patient s right as far as possible Meanwhile at the right margin of the lesser omental sac, dissection must be kept close to the wall of the stomach because the midcolic vessels lie immediately beneath and may be injured by careless mass ligatures As soon as dissection about the pylorus becomes somewhat difficult, the attack on the greater curva ture is stopped and the stomach elevated Light adhesions binding the pancreas to the lesser curvature will often be found These should be divided so far as is possible particularly around the area of the left gastric artery

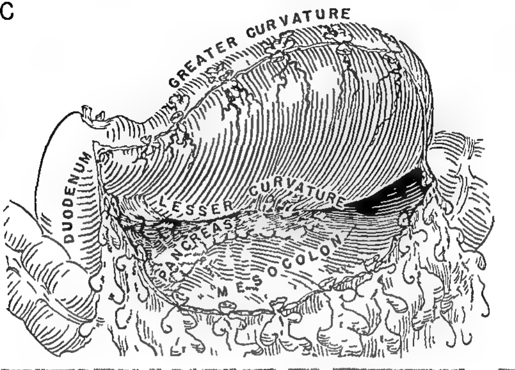
D —The next step consists in ligation of the left gastric artery The filmy lesser omentum is opened When the subject is thin it is possible to identify the artery between the celiac axis and the stom ach and to divide it at this level More often the descending branch of the artery will be interrupted on the gastric wall about 1 in distal to this point (Plate 45 *E*) It is always wise to apply three clamps to the vessel Section of the artery is then carried out between hemo stats 2 and 3 This leaves two clamps to protect the short left gastric artery stump The artery is then doubly ligated first tying and removing hemostat *1* then placing the second tie and removing hemostat 2

These precautions may seem useless but, if a single ligature is used and is defective there may be a terrifying and dangerous hemorrhage

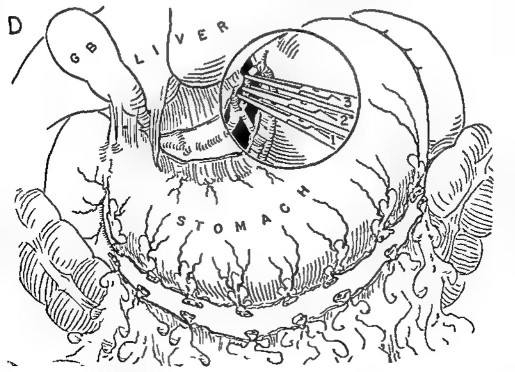
The proportional amount of lesser curvature to be excised can be estimated quite accurately by palpating the esophageal hiatus and measuring the distance to the pylorus Usually if the left gastric artery is divided at the level of its highest branch 75 per cent of the lesser curvature will be removed If it is divided near the third branch 50 per cent will be removed

[Gastric resection *continued on page 180*]

C


GREATER CURVATURE
DUODENUM
LESSER CURVATURE
PANCREAS
MESOCOLON

D


GB
LIVER
3
2
1
STOMACH

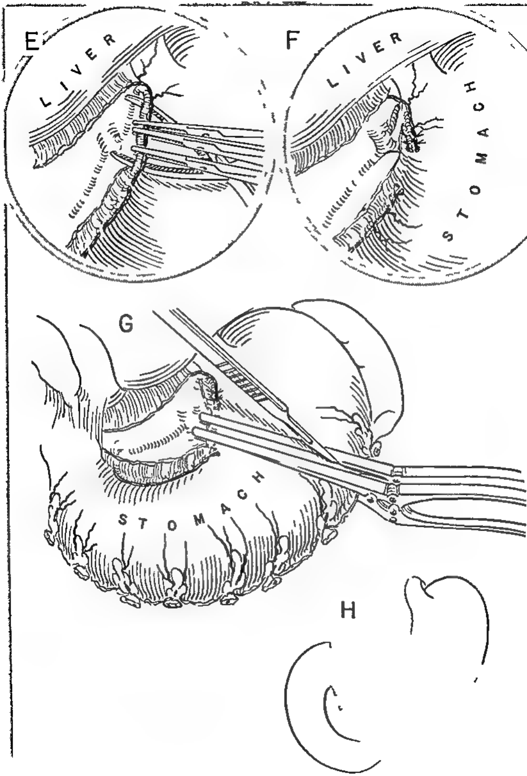
E—However, in most cases there is enough fat about the left gastric vessel to make accurate identification of the artery difficult. As a usual rule then the vessels are ligated on the wall of the stomach about 3 cm below the esophagus The easiest way to do this is as follows A Kelly hemostat is passed from anterior to posterior immediately adjacent to the wall of the stomach It is then spread sufficiently to allow the passage of three clamps that seize the artery vein and surrounding fat en bloc Division is then done so that there is one distal and two proximal clamps The proximal end is doubly ligated as described in *D* For this particular tie heavy ligatures of #1 chromic catgut are advisable

F—The proximal ends of the left gastric vessels have been ligated About 2 cm of the lesser curvature is then cleared distal to that point and the distal end of the artery tied

G—Preparations are now made to divide the stomach For this purpose Payr clamps are used since they securely control the cut ends of the stomach wall Some surgeons may use other clamps or none at all since accurate hemostasis can be obtained by division of the serosa and muscularis with individual ligation of the submucosal vessels such a method usually consumes more time and in the end is no less traumatic The stomach may be divided with scalpel or cautery With the scalpel devitalization of tissue is reduced to a minimum Further any active bleeding from mucosal vessels is controlled more delicately by tiny individual ligatures after the clamp is removed than by indiscriminate thrombosis from the cautery

H—The actual amount of stomach to be removed is shown diagrammatically The pathologist will find when he dissects the specimen that the lesser curvature of the specimen is 10 cm or slightly more in length and the greater about 20 cm

[Gastric resection *continued on page 182*]


E
LIVER
F
LIVER
STOMACH
G
STOMACH
H

I.—A small piece of gauze is tied over the distal Payr clamp to minimize contamination The pylorus is then visualized and the right gastric artery divided just above the stomach The duodenum must now be mobilized for a distance of at least 2 cm beyond the pylorus This involves the division of the hepatoduodenal ligament and individual dissection of vessels on the superior inferior and posterior walls of the first portion of the duodenum In addition the anterior wall must be cleared of any omental adhesions This procedure must be done with meticulous care to avoid hematomas or injury to the duodenum If the dissection is hard various suggestions made in the discussion on the difficult duodenal stump should be followed

J.—The posterior blood supply of the duodenum is furnished by short vessels that arise from the gastroduodenal artery they must all be divided between fine hemostats and ligated The gastroduodenal artery itself is not ligated except for acute massive hemorrhage since this procedure may vitiate the blood supply of the duodenum

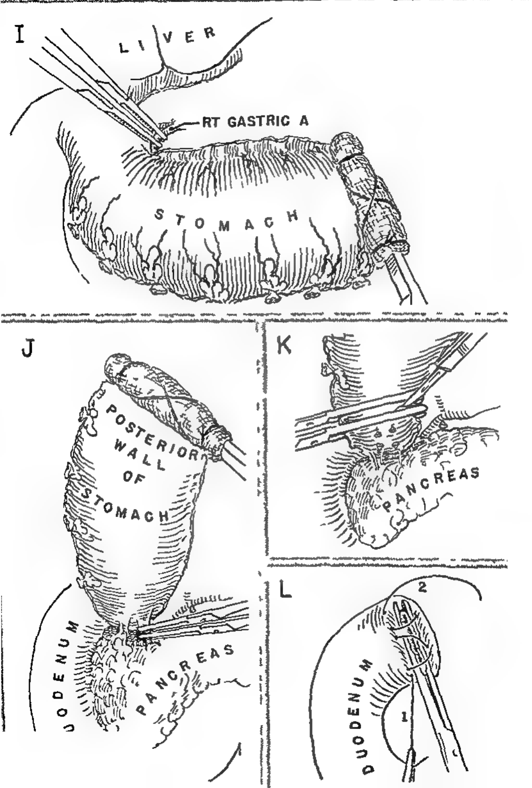
K.—If the duodenum can be mobilized easily dissection is carried below the ulcer to secure duodenum that is less scarred If it is difficult to clear the duodenum and there is sufficient normal duodenum between ulcer and pylorus the duodenum may be divided just distal to the pylorus and turned in proximal to the ulcer Often old scar of a healed ulcer is sufficiently flexible to allow division directly through it In any event a minimum of 2 cm duodenum must be mobilized beyond the line of division to secure an adequate turn in and utmost care taken to avoid trauma to the pancreas

L.—The duodenal stump is now inverted Though many methods have been described the one illustrated is applicable to most situations With a 00 catgut on a small curved nontraumatic needle a Connell suture is laid over the clamp beginning on the greater curvature side (*1*) In this figure the number of bites taken has been reduced to show the detail of application Usually about three bites are required on either side of the clamp it is important to put them in rather loosely on the clamp and to avoid too many bites

In some cases particularly when the resection is done for massive hemorrhage it is better to divide the duodenum without clamps to be sure no bleeding point is left distally The stump is then closed as shown in Plate 50

[Gastric resection *continued on page 184*]

PLATE 45


I
LIVER
RT GASTRIC A
STOMACH
J
POSTERIOR WALL OF STOMACH
DUODENUM
PANCREAS
K
PANCREAS
L
2
1
DUODENUM

M—The clamp is now withdrawn and the suture immediately tightened Gentle pressure on the duodenum with gauze at either end of the suture will aid in this maneuver

N—The same suture is then used to invert the first row A semi pursestring is necessary to turn the corner This requires either two or three sutures placed about 1 cm distal to the first row As the suture is tightened the upper angle of the first row is then depressed into the duodenal lumen Complete inversion of the upper angle results

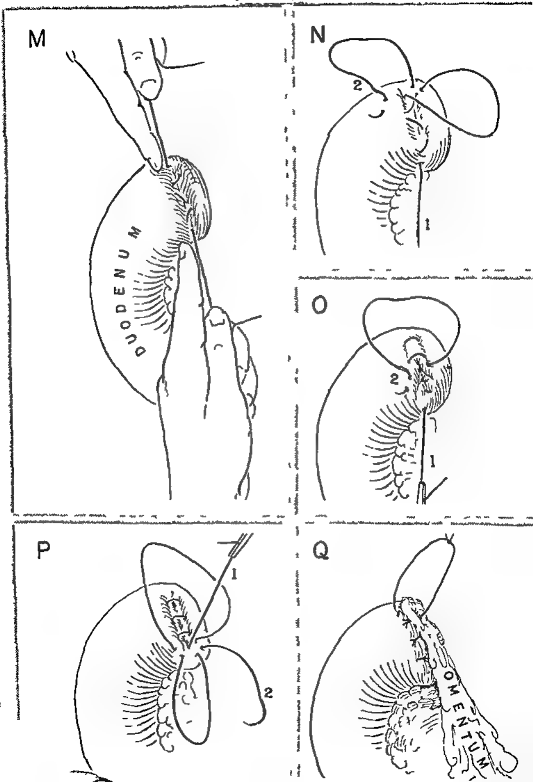
O—The running stitch is continued being applied similarly to the first row Care is taken to secure a complete inversion of the inner row

P—As the lower angle is reached it is inverted by a second semi pursestring again taking two or three bites as required As this angle is inverted it is important to remember that all tension must be on the needle end of the suture (*2*) while the original end (*1*) must be completely relaxed Thereafter *1* is tied to 2 and the second layer is complete

Q—A third layer of interrupted sutures is then placed Whether they are of catgut silk or cotton will depend on the surgeon s preference Catgut *is slightly more elastic and may have less* tendency to pull through if unexpected edema should arise in the postoperative period Nonabsorbable sutures must not be tied too tightly If the duodenum is soft and mobile Lembert sutures may be used but if it is edematous Halsted sutures are better The posterior bites of this third row of sutures are placed in the wall of the duodenum whenever possible rather than in the pancreatic capsule If the posterior wall of mobilized duodenum is so short that a third row of sutures cannot be inserted into it this row may be run from anterior duodenal wall to pancreatic capsule If this is done utmost care must be taken to avoid the gastroduodenal artery and its small branches Finally a tab of omentum may be tied lightly over the stump

[Gastric resection *continued on page 186*]

PLATE 45



R —Attention is now turned to the proximal stomach The Payr clamp is removed and the margin of the stomach is caught imme diately by a row of Allis forceps which will reduce leakage and pre vent loss of blood

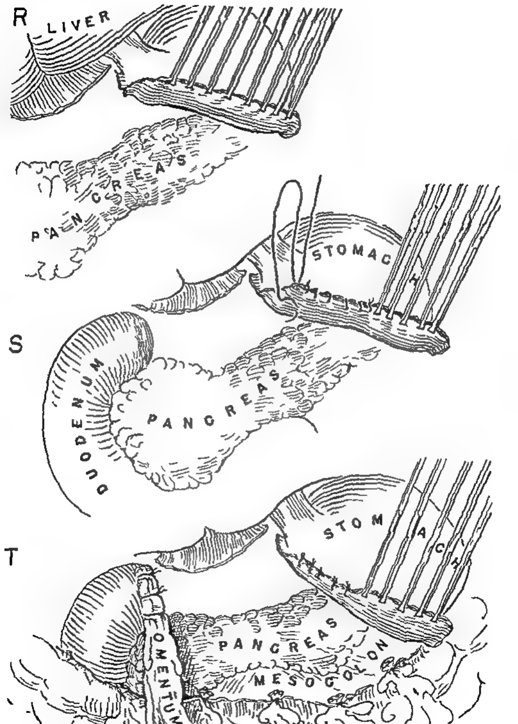
S —Approximately the upper half of the cut end is now turned in The first row of continuous 00 catgut sutures effects hemostasis The second inverting row of Lembert sutures is preferably of interrupted nonabsorbable material The sutures begin at the upper end and are continued downward until a stoma of the proper size is left

Much has been written about the correct size of the gastroenter ostomy stoma It seems that the rate at which food is discharged into the efferent loop is dependent more on the diameter of the jejunum than on the length of the gastroenterostomy stoma The stoma there fore need not be large to function well On the other hand if it is too small delayed gastric emptying in the early postoperative period may be a troublesome feature In this figure the inner row of sutures has been placed tied at both ends and the long ends of the catgut suture cut The inverting row is being started at the lesser curvature A stoma about 5 cm in length is satisfactory

T —The turn in of the upper portion of the cut end of the stomach has been completed

If the surgeon desires to remove the section of stomach adjacent to the anastomosis that was traumatized by the Payr clamp it can now be excised by the scissors hemostasis secured and the cut mar gins of the stomach again controlled by Allis forceps Usually it is not necessary to excise this narrow strip of tissue

[Gastric resection *continued on page 188*]


R
LIVER
PANCREAS
S
STOMACH
DUODENUM
PANCREAS
T
STOMACH
OMENTUM
PANCREAS
MESOCOLON

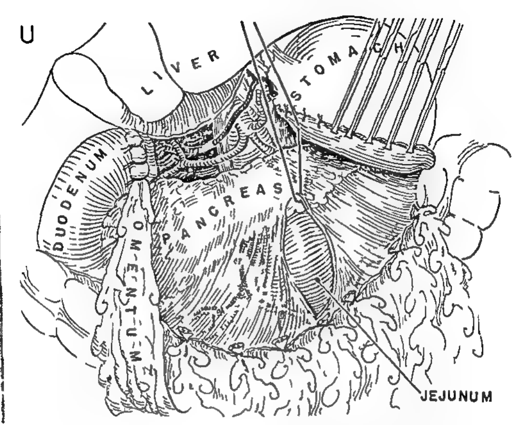
U —It is now necessary to decide whether a postcolic or an antecolic anastomosis is to be made The postcolic is described in figures *U–AC* and the antecolic will be illustrated in *AD–AF* When a postcolic anastomosis is to be made the transverse mesocolon must be opened and the margins of the rent sutured to the stomach well above the gastrojejunostomy Two particular complications may arise from the opening in the mesocolon In the first the anchoring sutures to the stomach wall tear out and the mesocolon falls downward and constricts the afferent and efferent jejunal loops leading up to the anastomosis This is an unusual but important cause of early postoperative stomal obstruction In the second the mesocolon may not be anchored firmly enough with the result that a lower loop of jejunum may later herniate through the opening to produce intestinal obstruction

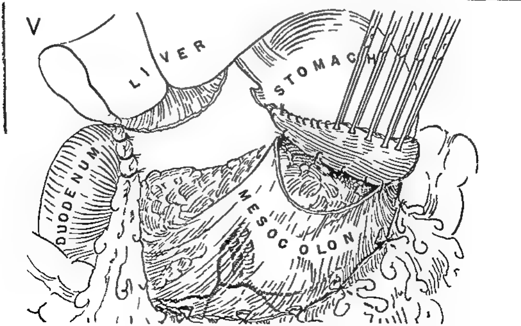
The transverse colon is elevated and the mesocolon is opened to the left of the midcolic artery for a length of about 8 cm The left side of the rent in the mesocolon is then attached to the stomach at least 3 cm above the prospective gastrojejunostomy The first suture catches the deep angle of the rent to the stomach near the lesser curvature The jejunum is visible through the opening in the mesocolon

V —Suture of the left side of the mesocolon to the stomach has been completed Further mobilization of the proximal jejunum may be achieved if necessary by partially dividing the ligament of Treitz.

It is particularly important to place the opening in the mesocolon well to the left of the midcolic artery if it is made to the right, the jejunal loops may be angulated by the taut artery and stomal obstruction occur This rent is made in an avascular area so that generous bites may be taken in the mesocolon to secure firm anchorage

[Gastric resection *continued on page 190*]


U
LIVER
STOMACH
DUODENUM
PANCREAS
OMENTUM
JEJUNUM


V
LIVER
STOMACH
DUODENUM
MESOCOLON

W —The proximal jejunum is now brought up through the mesocolon The suture to the stomach should be made in such a way that the jejunum will lie without torsion or tension and the afferent loop must not be so long that it kinks Suture of jejunum to stomach is done with a layer of interrupted silk or cotton This row of sutures begins about 2 cm above the projected gastroenterostomy to form a valve to prevent gastric contents from entering the proximal jejunum The sutures should catch the jejunum about 1 cm toward the mesenteric side so that the final stoma will be exactly along the antimesenteric margin The stomach is caught about 1 cm below the cut edge with each suture

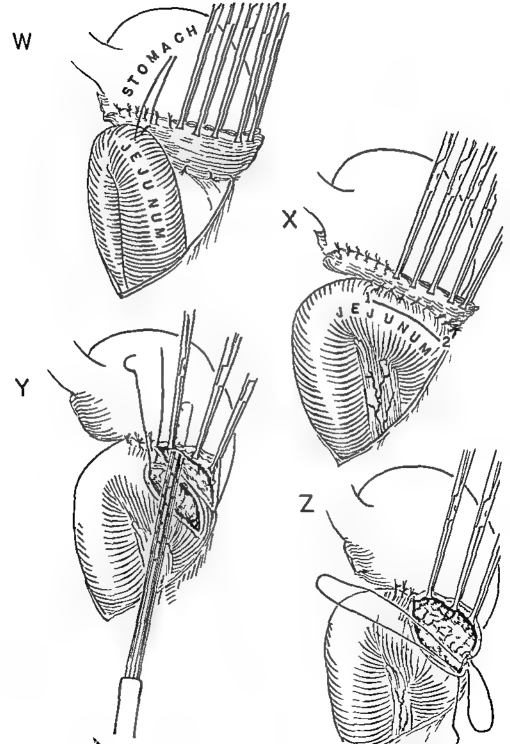
The length of the stoma is a subject of much discussion Most surgeons believe that the length of the stoma has little to do with the postoperative function and make it 4–5 cm long

X —The jejunum has been attached to the stomach It is now opened along the line *1–2* which corresponds to the length of the gastric stoma Any active bleeders in the jejunal mucosa are then individually ligated with 000 plain catgut

Y —The Allis clamps are removed and the stomach is opened and emptied with a suction tip Any bleeding vessels in the gastric mucosa then are ligated It is well to visualize the suture line along the upper portion of the lesser curvature to be sure it is absolutely dry The mucosal suture is placed using 00 nontraumatic catgut, beginning at the upper end

Z —The mucosal stitch is carried down to the lower angle of the anastomosis locked and continued around the lower angle with a Connell inverting suture At the conclusion of this step the posterior margin of the anastomosis must be completely free from bleeding

[Gastric resection *continued on page 192*]


W
STOMACH
JEJUNUM
X
JEJUNUM
1
2
Y
Z

AA —The anterior inner row of 00 catgut is begun at the upper angle and carried down either as a simple running or Connell suture. The ends of the two catgut sutures are then tied together completing the inner row

AB —The anastomosis is completed by a row of interrupted non absorbable sutures

AC —The transverse colon again is elevated and the anastomosis drawn down gently, so that the entire jejunum and 2-3 cm of stomach lie below the rent in the mesocolon The right side of the rent in the mesocolon is then sutured to the anterior wall of the stomach

This completes the anastomosis Under certain circumstances it is wise to supplement the resection with double jejunostomies (Plate 70) The abdomen is closed in layers without drainage

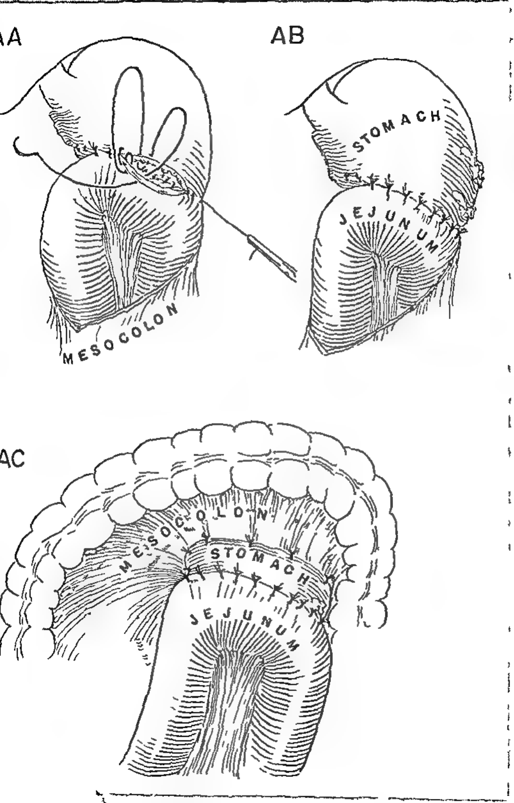
It will be noted that there is a trap formed by this anastomosis so that a loop of small intestine may herniate behind the anastomosis in front of the mesocolon This special type of internal hernia, first described by Petersen fortunately is uncommon The afferent loop should be short, so that it is almost impossible for the hernia to occur If the afferent jejunal loop is long it may be sutured to the mesocolon to close the trap but care must be taken to avoid angulation

After care —Postoperatively unless the stomach is decompressed by a jejunostomy catheter the Levin tube should be left in for 48 hours Thereafter intermittent aspirations are used Intravenous fluids and chemotherapy are continued for about five days and then are discontinued unless complications have developed A blood transfusion of 500 cc is given routinely at the time of operation and repeated at later intervals in the convalescence if necessary

Complications are not infrequent They will be discussed in detail in a later section The mortality for elective gastric resection for duodenal ulcer should range from 1 to 3 per cent at the present time

REFERENCES Petersen Cannon and Weeks

[Gastric resection *continued on page 194*]


AA
MESOCOLON
AB
STOMACH
JEJUNUM
AC
MESOCOLON
STOMACH
JEJUNUM

When an antecolic anastomosis is contemplated the preliminary steps are exactly as those described from *A* to *T* inclusive except that the omentum preferably has been removed

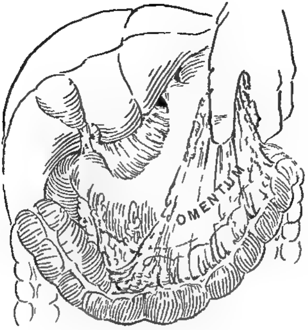
AD —Removal of the omentum is wise if it is thick or is adherent to other abdominal scars since it may interfere with adequate function of an antecolic anastomosis In some instances, when the omentum is poorly developed it may be left In other cases it may be too adherent in the lower abdomen to mobilize completely in such an event separation of a section of omentum from the colon will be necessary to allow adequate freedom of the jejunal loops about the anastomosis Here the entire omentum is being elevated by an assistant and separated from the colon by the surgeon standing on the left side of the table

AE —After the resection has been completed and the upper portion of the transected end of the stomach closed by the Hofmeister technic the surgeon must decide whether to place the afferent loop at the greater or lesser curvature In the Moynihan method the afferent loop is short and is attached to the greater curvature There is an angulation produced at the lesser curvature by this method Too great an angulation may produce stomal obstruction A moderate amount of angulation has been considered by Lahey and his co workers to be desirable since it slows gastric emptying and may thereby reduce the incidence of the dumping syndrome

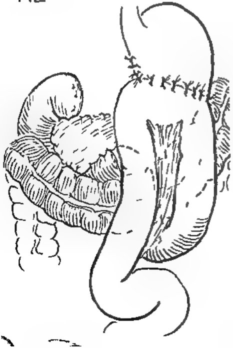
AF —In some instances the anastomosis apparently will lie more comfortably if the afferent loop is at the lesser curvature A somewhat longer afferent loop is necessary but the hazard of too sharp an angulation at the lesser curvature is avoided Either anastomosis is made by the two layer technic illustrated in figures X *AB*

PLATE 45

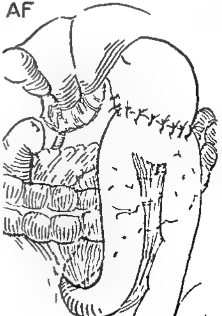
AD



AE



AF



First Stage

The two stage gastrectomy described by McKittrick Moore and Warren divides the procedure of gastric resection into two component parts separating the two operations by an interval of six weeks The purpose of the first stage is to defunction the duodenum by the complete division of the stomach and the formation of a gastrojejunostomy At this time the midportion of the stomach also is removed At the second stage the distal stomach and proximal duodenum are resected

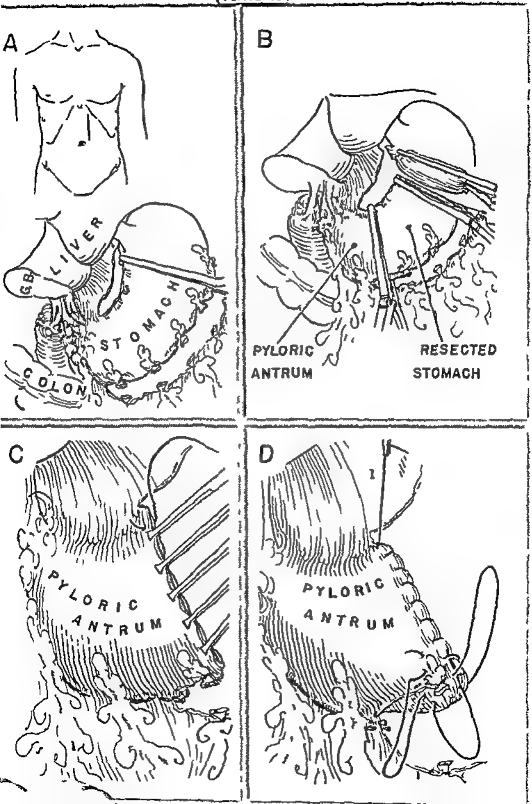
A—The abdomen is opened through a left paramedian incision (Plate 6) Exploration has shown that mobilization of the duodenum will be hazardous *The decision to do a two stage gastrectomy must be made now* rather than later when blood supply to pyloric antrum and duodenum has been jeopardized Both greater and lesser curvatures are then mobilized just as in the usual resection except that the branches of the right gastroepiploic artery are not separated from the distal 2 or 3 in of stomach and the right gastric artery is not divided The blood supply of the defunctioned distal stomach will depend on these vessels Payr clamps are applied just below the upper quarter of the stomach and the stomach divided

B—Dissection is carried distally to a point 2–3 in proximal to the pylorus Inversion of the antrum is impossible if the division is closer to the pylorus If the stomach wall is thickened the section should be even farther from the pylorus

C—The Payr clamp has been removed and replaced by a row of Allis forceps The inner suture of 00 catgut is now begun

D—The inner layer has been carried across the cut end as a Connell suture The lower angle is now inverted with a semi pursestring

[First stage *continued on page 198*]


A
LIVER
GB
STOMACH
COLON
B
PYLORIC ANTRUM
RESECTED STOMACH
C
PYLORIC ANTRUM
D
I
PYLORIC ANTRUM

E—The second row has been completed by running the catgut suture back up to the cut end of antrum and tying to suture *1* in *D* The details of the application of these two rows are similar to those described for inversion of the duodenal stump (Plate 15) A third row of nonabsorbable sutures is now being put in

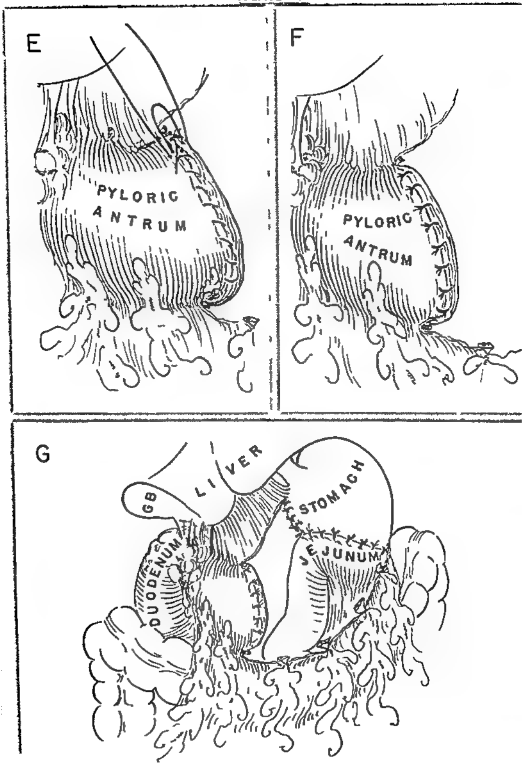
F—The third row has been completed Attention is now turned to the proximal segment of stomach and a gastroenterostomy performed in the usual manner preferably by the posterior Hofmeister technic described in Plate 45

G—The appearance of the stomach at the conclusion of the first stage is shown here

Postoperatively the course is usually remarkably smooth However certain warnings are necessary (1) This operation is not recommended for acute massive hemorrhage (2) If there has been excessive manipulation of the duodenum or disturbance of the blood supply of the antrum during the operation the duodenal ulcer may perforate postoperatively or the antral suture line may separate (3) Unless the second stage is performed within six to eight weeks after the first an anastomotic ulcer probably will form Under exceptional circumstances a stomal ulcer has been noted as early as three weeks after the first stage Consequently any delay in performing the second operation must be avoided (4) If the difficult dissection is caused by an old ulcer with extensive fibrosis and scarring, much less resolution can be expected than occurs when there is an acute ulcer with well marked edema and acute inflammation

The comparatively long period of disability and the frequent rapid development of an anastomotic ulcer have made this operation unpopular with many surgeons In view of the good results which have followed antral exclusion combined with vagotomy (Plate 54 *D*), it seems clear that the first stage of a contemplated two stage resection should be accompanied by vagotomy making the second stage of the operation unnecessary

[Second stage of resection *on page 200*]


E
PYLORIC
ANTRUM
F
PYLORIC
ANTRUM
G
LIVER
GB
STOMACH
JEJUNUM
DUODENUM

Second Stage

A—The abdomen has been opened through a right upper rectus splitting incision to maintain a space of at least 2 in between the new incision and the recent upper left incision The antrum of the stomach is usually somewhat hard to identify at first because of fresh adhesions These however are separated readily and the pyloric segment can then be elevated with Allis forceps

B—Mobilization of the duodenum is accomplished by division of the vessels along the greater curvature the right gastric artery the hepatoduodenal ligament and the branches of the gastroduodenal artery that enter the posterior wall

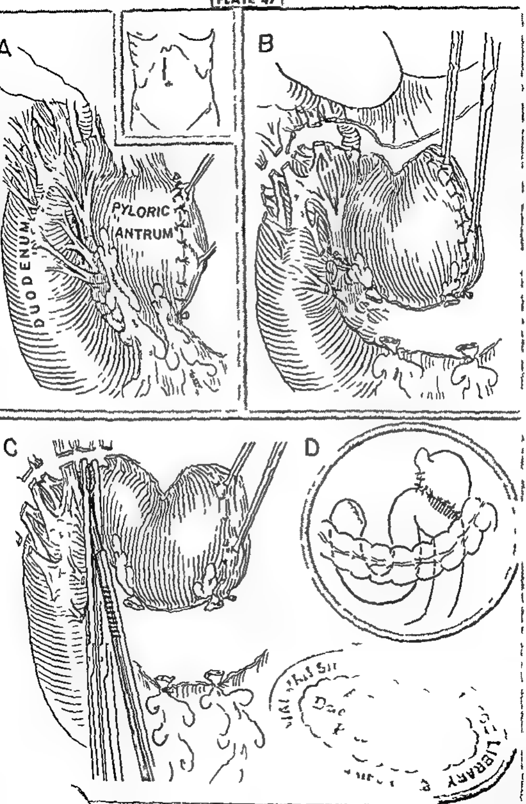
C—The ulcer usually has healed at this stage and the duodenum is divided through the scarred area at any point distal to the pylorus The duodenal stump then is turned in by the usual method (Plate 45)

D—At the conclusion of this operation a typical gastric resection with posterior Hofmeister anastomosis has been accomplished

Unless one has had personal experience with the two stage resection it is impossible to appreciate the tremendous contribution it has made to the safety of the operation The proximal duodenum may be nonresectable in the hands of even the most able surgeon at the first stage and still be safe for a house officer to remove at the second operation The two stage procedure therefore should be used more widely by less experienced surgeons With increasing experience each surgeon will use it less frequently

REFERENCE McKittrick Moore and Warren

PLATE 47



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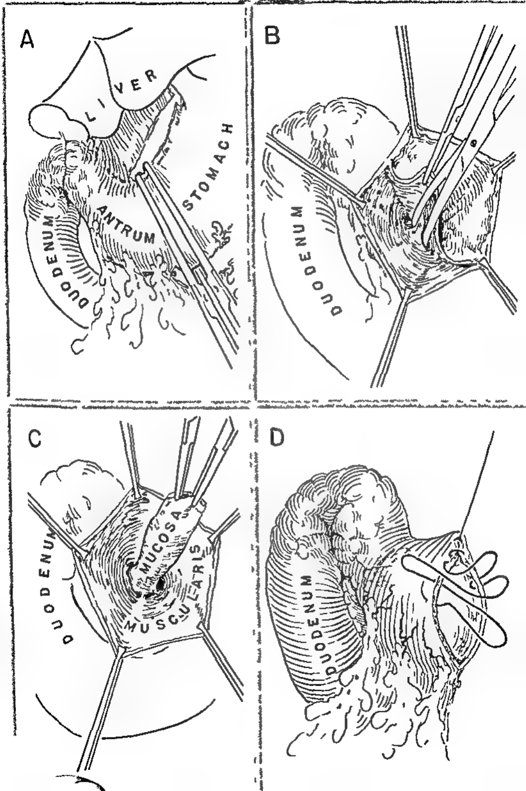
REFERENCE McKittrick Moore and Warren


A
LIVER
STOMACH
ANTRUM
DUODENUM
B
DUODENUM
C
DUODENUM
MUCOSA
MUSCULARIS
D
DUODENUM

The Bancroft operation is similar to the first stage of the two stage resection except that the mucosa of the pyloric antrum is re moved at the original operation eliminating the need for a second procedure Unfortunately this variation offers serious technical prob lems that may counterbalance this great advantage

The upper portion of the gastrectomy and the gastrojejunostomy are performed as usual (Plate 45) The details of the management of the pyloric stump are shown

A —Mobilization of the stomach has been completed and the an trum is being divided about 2½ in proximal to the pylorus If the stomach is divided closer to the pylorus it will be impossible to invert the cut end because of the small lumen of the antrum close to the pylorus Note that the right gastroepiploic and right gastric vessels have not been separated from the antrum thus, an adequate blood supply to the stump will be maintained

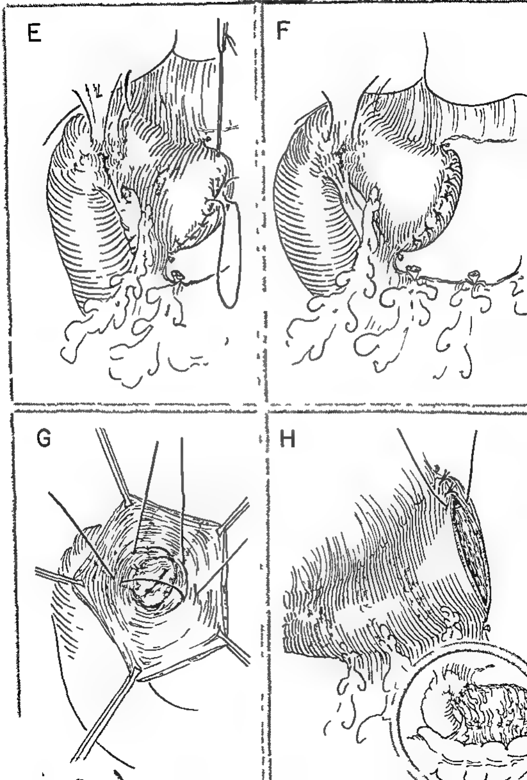
B —The distal clamp is now removed A cleavage plane between mucosa and muscle is easily obtained The muscle is grasped with several Allis clamps and the mucosa is elevated and dissected down to the pylorus There often is active bleeding as this is done It is possible to tie a number of vessels as the mucosa is coned out Utmost care must be taken to avoid perforation of the muscularis

C —The pylorus has been reached Identification of the pylorus may be difficult It usually can be palpated with the tip of the finger and circular muscle fibers often can be seen

D —Hemostasis has been completed The stump is now closed A running Connell suture is placed to invert the first row

[Bancroft operation *continued on page 204*]

PLATE 48



E—The inner suture has been completed and the second invert ing layer is being continued upward toward the lesser curvature Note that inversion of the lower and upper angles of the cut margin of the stomach is difficult because they must be funneled into the antrum the width of which diminishes steadily down to the pylorus

F—A third layer of interrupted sutures completes the turn in This should be reinforced by omentum

Disadvantages—(1) Leakage is distressingly common owing to many factors Sutures hold poorly in muscle alone Lack of blood supply may cause perforation between suture line and pylorus An almost complete pyloric obstruction may become complete from post operative edema and a collection of blood between pylorus and suture line may produce a blowout Therefore a drain should be placed near to but not in apposition with the suture line in the hope that general peritonitis may be avoided if a blowout occurs Bruus gaard has sutured the stump in the abdominal wall obtaining a fistula instead of peritonitis if there is dehiscence of the suture line (2) During the pyloric dissection some of the antral mucous mem brane may be inadvertently left and may lead to an anastomotic ulcer (3) Rarely the duodenal ulcer may perforate or bleed post operatively Hence *any manipulation of the ulcer that is to be treated by this method must be avoided*

Plenk closure—An alternative method of closure was described independently by Scrimger and by Plenk It is endorsed enthusiasti cally by Makkas and Marangos In the few instances in which we have used it it has been very satisfactory

G—Leakage is prevented by close apposition of the antral walls rather than by inversion The mucosa excised down to the pylorus is ligated at the pylorus with a catgut suture A layer of interrupted silk sutures is now placed about 2 cm distal to the pylorus from within the stomach catching both anterior and posterior antral walls These sutures must not penetrate the muscularis This row is then tied

H—In all three or four rows of sutures are inserted depending on the length of the antrum Hemostasis must be complete so that no hematomas form between suture lines The final row merely apposes the cut ends no attempt at inversion is made Finally the entire antrum is wrapped in omentum

of Vater will probably be impossible It is well to remember that inflammation may shorten the duodenum so that an ampulla may be less than 2 in rather than 3 or 4 in distal to the pylorus Instead of attempting a precarious suture or a transplantation of the common bile duct it is best then to use a catheter duodenostomy with double jejunostomy

When the surgeon is unsatisfied with the closure the stump should be covered with *omentum* and a drain placed through a stab wound to Morison's pouch the drain should not touch the suture line Drainage should also be instituted if there has been extensive pancreatic dissection The surgeon must not be lulled into a false sense of security by the mere presence of a drain If dehiscence of the stump does not occur until several days after operation the wick may be completely walled off and will not function Furthermore even if it does function well death may still result from complications arising from the fistula However we believe that primary drainage tends to reduce the incidence of general peritonitis following rupture of the duodenal stump and to reduce the operative mortality

When in difficult cases the surgeon has become involved in a resection and cannot extricate himself by performing a vagotomy with some ancillary procedure by closure of the duodenum proximal to the ulcer by a Bancroft or by a two stage operation he must resort *to one of the methods illustrated in the next series of plates* (1) choledochostomy for accurate identification of the common duct (2) plastic closure of the duodenum distal to the ulcer or (3) catheter duodenostomy

The Difficult Duodenal Stump

The technical management of the duodenum is not difficult when a resection has been done for gastric ulcer or cancer But after gastrectomy for duodenal ulcer success or failure depends on the handling of the duodenal stump The experienced surgeon needs little advice in this regard but for the benefit of others this section is included

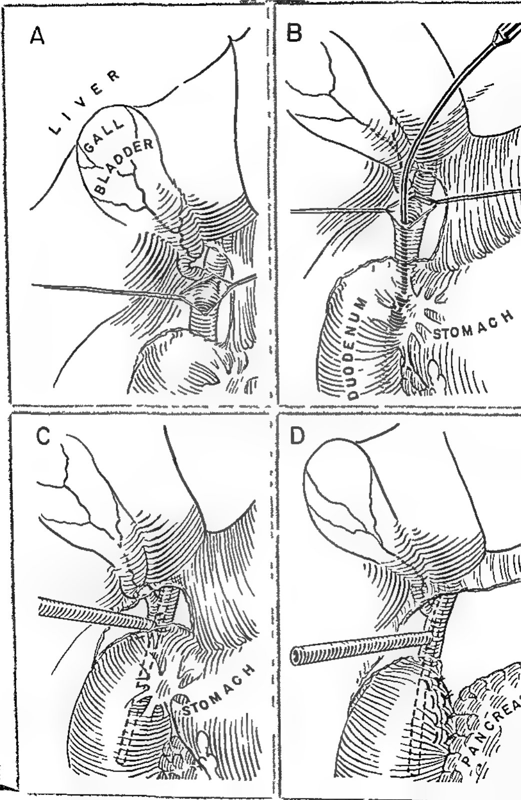
When the operation is for acute massive hemorrhage it is desirable to excise the ulcer and close the duodenum beyond it In other cases so far as the late result of the operation is concerned it makes no difference where the distal stomach or duodenum is sectioned as long as the antral mucosa is excised The immediate problem then is to close the stomach and duodenum either distal or proximal to the ulcer or to prevent by other means the escape of duodenal contents within the peritoneum Meanwhile excessive manipulation and dissection in the head of the pancreas must be avoided as far as possible because of the danger of pancreatitis

It is well to remember that management of the duodenum usually will prove more troublesome than it seems at first glance, since the extent of penetration of the ulcer in the pancreas cannot be determined until the stomach is transected and the whole posterior wall mobilized Nevertheless the surgeon must attempt to decide as soon as he begins the operation whether or not dissection can be safely carried beyond the pylorus If dissection can be carried past the duodenal ulcer easily it is best to excise the ulcer and close the duodenum distal to it If resection looks difficult, the surgeon should elect vagotomy combined with antral exclusion gastroenterostomy or pyloroplasty to avoid the hazards of the duodenal stump

Frequently, however the surgeon will find that he has advanced beyond the pylorus and that in the midst of such periduodenitis he must proceed farther if closure is to be made Under these circumstances it is best to place the left index finger in the open duodenum and dissect closely about the duodenum until the ulcer has been passed and normal duodenum which can be turned in encountered During this mobilization the common duct must be observed and if necessary a T tube inserted into it

In certain instances, it will be found that the ulcer and periduodenal inflammation are so extensive that closure above the ampulla

PLATE



Lahey's Method

When dissection of the duodenum is difficult, the surgeon can easily damage the common duct Either a partial section of the duct or complete ligature is almost certain to be fatal unless recognized and corrected within a few days To avoid these serious complications, Lahey has advised a choledochostomy in all difficult cases

A —The duodenum has been mobilized from the liver by division of the thickened hepatoduodenal ligament The common duct may lie immediately below the ligament The duct is identified by dissection and aspiration with a fine needle It is then opened and guy ligatures inserted

B —Bakes dilators are now passed through the ampulla until the duct is large enough to receive a T tube At least a #5 and preferably a #7, dilator should be passed into the duodenum

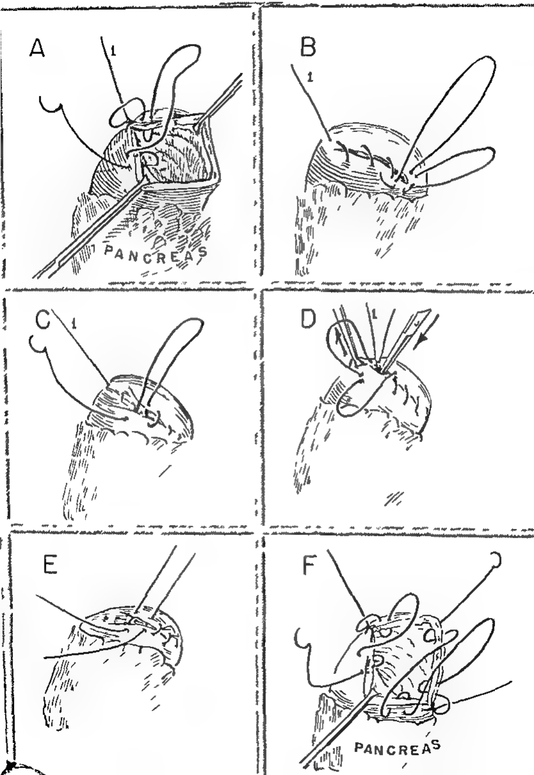
C —The common duct is then closed about the catheter with two layers of running sutures of 000 chromic catgut With the catheter in place the position of the duct can be determined by palpation and the duodenal ulcer resected and the stump closed Postoperatively the T tube provides excellent decompression of the duodenum

D —The duodenum is shown after resection and closure The lower arm of the Cattell tube extends through the ampulla into the duodenum

By this method the surgeon is able to excise safely some ulcers whose removal otherwise would be hazardous There is however much more dissection in the head of the pancreas than is desirable if it can be avoided It also should be noted that it is not always easy to identify the common duct in the midst of the periduodenal inflammation Hence when exclusion operations can be done they are preferred in our hospital

REFERENCE Lahey

PLATE 50



Open Closure

When the duodenal stump is mobile closure after gastrectomy presents no problems and can in most instances be accomplished by the aseptic technic that does not open the duodenum (Plate 45 *L–Q*) On the other hand an open closure is necessary if the duodenal lumen has been inspected as for example in the determination of a source of hemorrhage Since an open closure can be accomplished with a very short segment of duodenum it can be used when the stump is too short to close by the aseptic technic This is a much more accurate method than the Nissen or Bsteh methods illustrated in succeeding plates

A —In this drawing the surgeon is standing on the patient s left Only 1 5 cm of duodenum has been mobilized because of dense scar tissue posteriorly The anterior wall of the duodenum has been sectioned as close to the pylorus as possible and adhesions about it have been cut, since a mobile anterior wall is essential for a satisfactory closure Closure is started with a Connell suture (00 chromic catgut) which inverts only a small rim of serosa

B —The first layer has been completed and by tightening the Connell suture all mucosa is inverted A semi pursestring suture is now placed about the upper angle to invert the first row

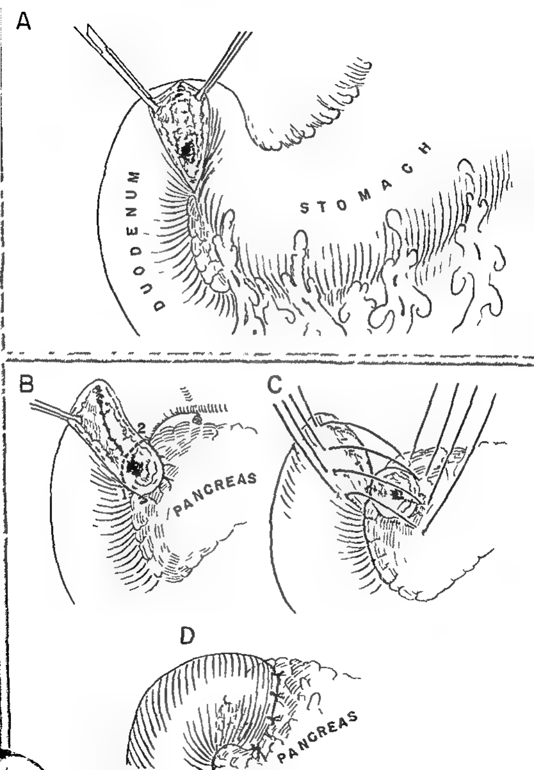
C —The same suture is continued back as a second layer with a running stitch

D —A semi pursestring is made with two or three bites that are placed nearly 1 cm away from the end suture (*1*) of the first row Inversion is now accomplished by pulling up on the running suture and relaxing suture *1* Elevation of the anterior wall of the duodenum by an Allis clamp will aid inversion

E —Final closure is effected by a third row of interrupted sutures Sutures of 00 catgut are preferred if the wall is edematous If non absorbable sutures are used care must be taken lest they be pulled too tightly

F —Occasionally there is very little mobility of the upper angle of the duodenal stump In this event accurate closure may be made by starting a Connell suture from each end tying the sutures as they meet in the middle This is then supplemented by two other layers of sutures if possible

PLATE 51



Graham's Method

The essential feature of this method of dealing with difficult duodenal ulcers is that the ulcer is not dissected from the head of the pancreas The ulcer is thereby left open but exteriorized from the intestinal tract This technic had been described previously by other surgeons (Plate 56) but has been commended and popularized by Graham

A —A posterior wall ulcer has been palpated The duodenum is opened widely just above the ulcer demonstrating the lesion on the posterior wall The duodenum will then be divided just proximal to the ulcer and the pylorus and stomach retracted to the left

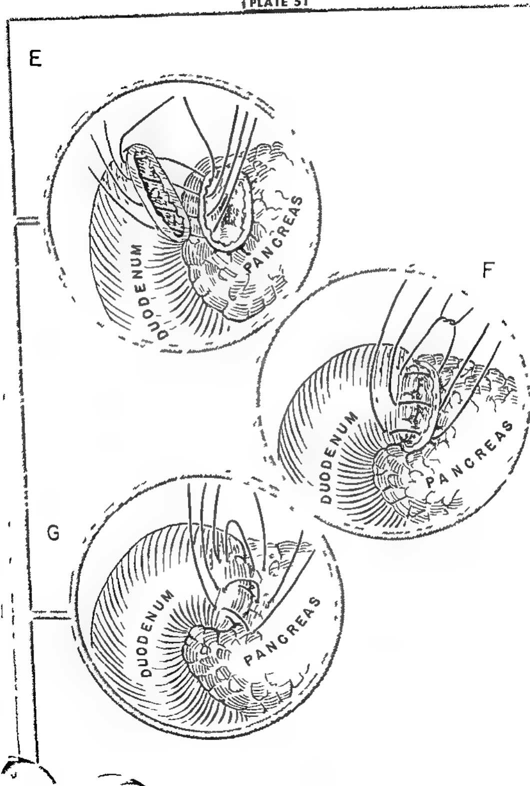
B —The open distal duodenum and ulcer are shown The posterior wall of the duodenum is now divided along the line *1–2* just distal to the ulcer This isolates the ulcer from the duodenum, and further mobilization of duodenum distal to the ulcer can now be made through normal tissue so that an adequate amount for a turn in can be obtained

C —The duodenum has been inverted by two layers of sutures (Plate 45) A third layer of Lembert sutures is now placed running from the anterior duodenal wall to the pancreatic capsule above the ulcer

D —As these sutures are tied the excluded ulcer is covered with normal duodenal wall Further reinforcement with omentum may be obtained

This method of dealing with the ulcer avoids much of the trauma to the head of the pancreas that occurs when the whole ulcer bed is traversed by dissection along the outer side of the duodenum It is not devoid of danger however since an accessory pancreatic duct may be cut during the mobilization of the duodenum Furthermore there is a tendency for fluid to collect between the ulcer bed and the duodenum and hemorrhage can occur from the excluded ulcer bed

REFERENCE Graham


E
DUODENUM
PANCREAS
F
DUODENUM
PANCREAS
G
DUODENUM
PANCREAS

Nissen's Method

Nissen's method of handling the deep, penetrating ulcer is similar to that of Graham except for minor details

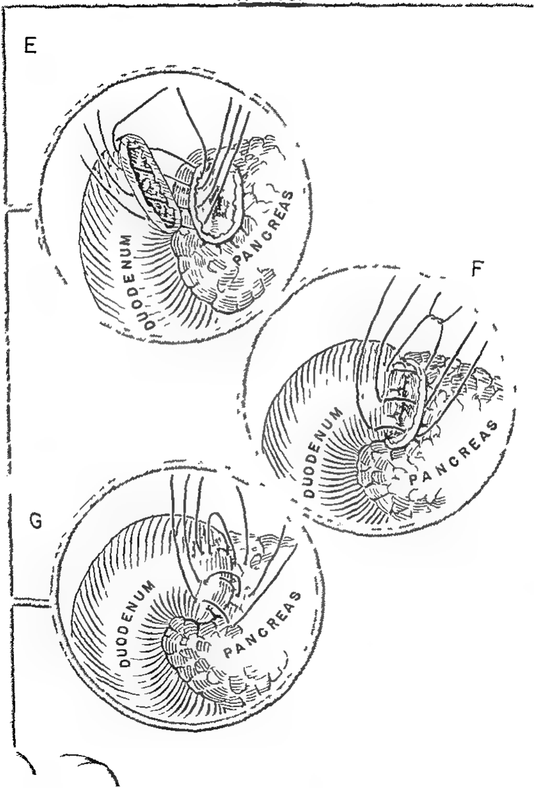
E —The duodenum has been mobilized along both curvatures opened anteriorly to demonstrate the posterior wall ulcer and then freed along the posterior wall so that the whole ulcer bed is opened The duodenum is then closed with three layers of interrupted sutures The first row catches the anterior wall of the duodenum the posterior wall and then the pancreatic capsule just below the ulcer These sutures are first placed then tied

F —The second row of sutures is placed through the anterior wall of the duodenum and the pancreatic capsule just above the ulcer This row likewise is first placed and then tied

G —It usually is possible to insert a third layer of sutures running from the anterior duodenal wall to the thickened pancreas to the left of the previous row This row may be reinforced by a layer of omentum

This method does not require as extensive a posterior dissection distal to the ulcer as Graham's method but the closure appears to be less secure since all of the first two rows of sutures are in immediate contact with the inflammatory tissue about the ulcer in the head of the pancreas

REFERENCES Nissen Bruusgaard


E
DUODENUM
PANCREAS
F
DUODENUM
PANCREAS
G
DUODENUM
PANCREAS

Bsteh's Method

Bsteh has presented a method for plastic closure of the duodenum that is possible when the anterior wall is freely mobile and there is a deep posterior wall ulcer The procedure depends on the retention of a long flap of the anterior wall which is then used to cover the ulcer

A—The duodenum is mobilized opened and the lower margin of the ulcer cut away just as in previous methods However the incision through the anterior wall is made as near the pylorus as possible so that a long tongue of the anterior wall remains The line of incision is shown in the diagram

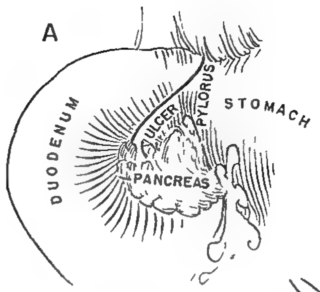
B—A row of interrupted sutures now catches the duodenum just beyond the cut margin of the anterior wall and the posterior wall of the duodenum distal to the ulcer The deep bites usually include thickened pancreatic tissue about the posterior duodenal wall although it is better to use only the duodenal wall itself

C—The second row catches the anterior wall of the duodenum and the upper margin of the ulcer as shown in this cross section Sufficient distance is allowed between the first and second rows of sutures on the anterior duodenal wall to permit complete covering of the ulcer bed by the duodenum

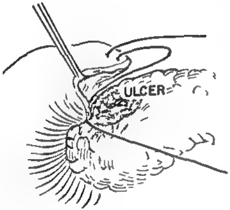
D—A third line of sutures now unites the anterior duodenal wall to the pancreatic capsule at the left of the ulcer In this figure a cross section of the completed operation is shown

REFERENCES Bsteh Bruusgaard

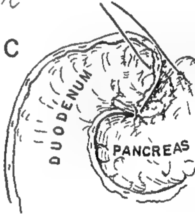
A


DUODENUM
ULCER
PYLORUS
STOMACH
PANCREAS

B


ULCER

C


DUODENUM
PANCREAS

D

Catheter Duodenostomy

Occasionally when operating for massive hemorrhage or for an ulcer with extensive periduodenal inflammation the surgeon finds there is no duodenum normal enough for closure without extensive dissection that may damage the pancreas or the common ducts This procedure properly done will allow the surgeon to extricate him self safely from this predicament Whereas the preceding methods require relatively mobile duodenum this one can be used even when the duodenum is thickened and fixed

A —The gastric resection has been completed A pursestring suture of 00 chromic catgut is placed around the open end of the duodenum

B —A #16 catheter has been inserted The pursestring is tied and the catheter anchored by a transfixion suture using the same needle

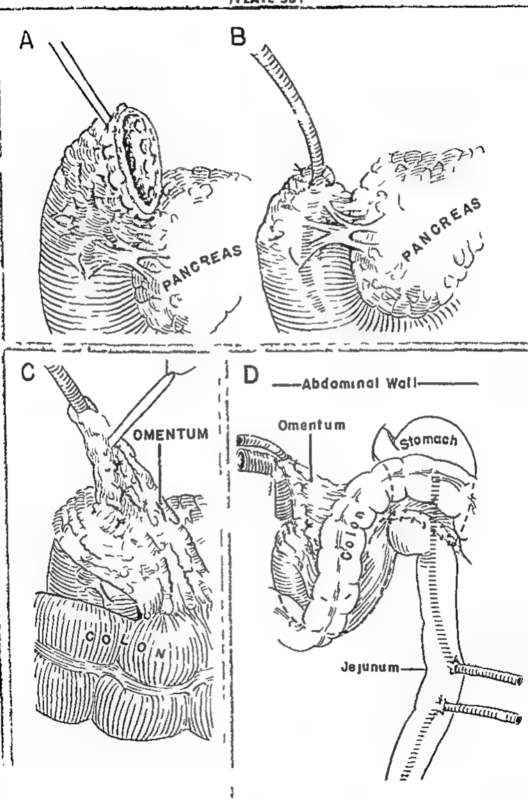
C —Additional sutures are used about the catheter to secure as much further inversion of the end of the duodenum as possible By irrigation with a syringe be certain a water tight closure has been obtained A generous portion of omentum is finally sutured to the duodenum and about the catheter

D —A cigaret wick has been placed in the region of the foramen of Winslow The wick and catheter are brought out through a stab wound beneath the right costal margin Finally a double jejunostomy is made (Plate 70) The appearance at the end of operation is shown

Postoperative care —The duodenal tube is allowed to drain by gravity If there is over 500 cc drainage daily the aspirate should be returned to the intestinal tract by the lower jejunostomy tube Mean while any undue distention of the stomach is prevented by the proximal jejunostomy tube The cigaret wick may be withdrawn in eight days and the duodenal catheter in 10–12 days The jejunostomy catheters are removed a few days later Needless to say there must be careful and frequent checks of blood chemistry during the period the tubes are in place

Subterminal duodenostomy —It is also possible to decompress the duodenum which has been closed in a dubious manner by means of a catheter inserted into a relatively normal section of duodenum

References Friedemann Welch and Rr lkey


A
PANCREAS
B
PANCREAS
C
OMENTUM
COLON
D
Abdominal Wall
Omentum
Stomach
Colon
Jejunum

Many other operations or combinations of the procedures outlined in previous pages have been used or are under trial for duodenal ulcer They fall roughly into two classes In one vagotomy is combined with an auxiliary procedure In the other the acid secreting area of the stomach is reduced by an appropriate excision

Vagotomy Combined with Other Procedures

A—Vagotomy and posterior gastroenterostomy or pyloroplasty The abdomen is opened through a left upper paramedian incision A subdiaphragmatic vagotomy is followed either by a short loop posterior gastroenterostomy that is placed in the most dependent portion of the stomach or by a pyloroplasty

B—Vagotomy and 50 per cent gastrectomy After the vagotomy has been completed a conservative gastric resection is done The stomach is divided at the midportion on the lesser curvature and at the junction of the gastroepiploic arteries on the greater curvature Gastrointestinal continuity is then re established

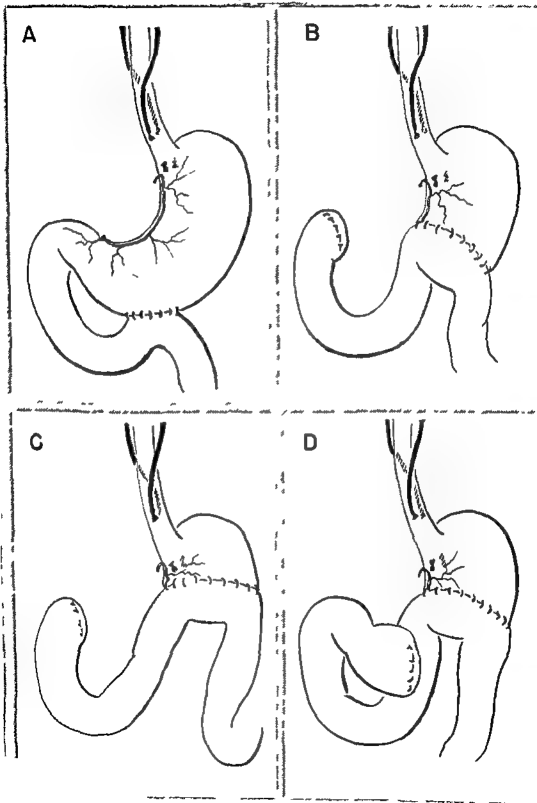
C—Vagotomy and subtotal (75 per cent) gastrectomy appears to be least likely to be followed by anastomotic ulcer although postoperative complications are more numerous than after resection alone

D—Vagotomy and antral exclusion Waddell has performed a vagotomy divided the stomach above the antrum turned in the antrum and anastomosed the proximal portion of the stomach to the jejunum This is a simple technical procedure with results similar to 50 per cent resection plus vagotomy Technical details are similar to those shown in Plates 46 and 47

All these operations have some advantages Thus *A* and *D* avoid the hazards of duodenal stump closure and as well as *B* should reduce the weight loss that sometimes follows 75 per cent resection Disadvantages include the postvagotomy complaints such as persistent diarrhea and the gradual recovery of hydrochloric acid secretion by the stomach The author believes that it is logical to add vagotomy to a 75 per cent resection when dealing with an extremely high gastric acidity or an anastomotic ulcer that has developed after gastric resection For the usual type of ulcer vagotomy plus 50 per cent gastrectomy gives excellent early relief and long term results

REFERENCES Dragstedt Walters *et al* Farmer *et al* Waddell

PLATE 54



seem closely comparable to 75 per cent resection without vagotomy

Reduction of Hydrochloric Acid Secretion

Reduction of the amount of secretion of hydrochloric acid may be effected by a wide anatomical excision of the area of the stomach that contains the parietal cells Wangensteen has investigated two of these operations

E —For the tubular resection the abdomen is opened by a vertical incision (*1*) that if necessary extends across the left half of the lower end of the sternum In *2* the dotted line indicates the area to be excised In *3* the greater curvature has been removed, and suture is started A pyloroplasty will be made after an incision along the dotted line The completed operation is shown in *4*

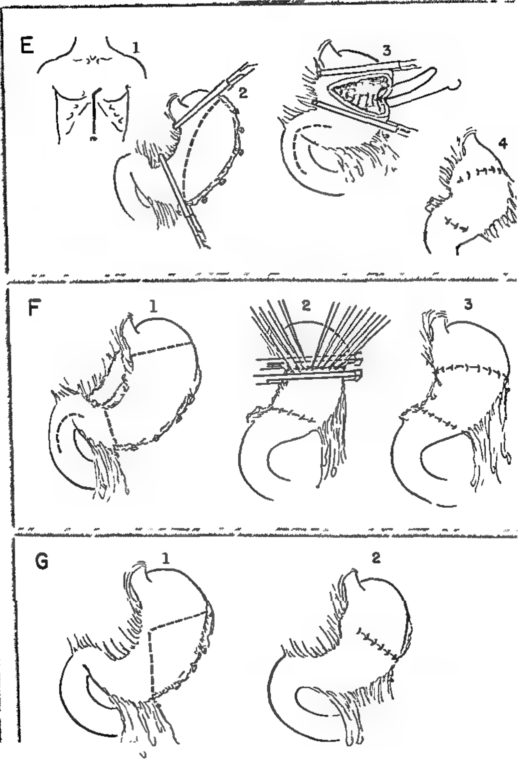
F —The segmental resection is an extensive sleeve resection that removes all of the stomach except a small section of the cardia and of the antrum (*1*) In *2* a pyloroplasty has been done because of a narrowed duodenum and gastric continuity is being re established The reconstructed stomach is shown in *3*

G —The prototype of these operations was Connell s fundusectomy Here a large wedge was removed from the greater curvature shortening the greater curvature considerably

Connell s operation fell into disrepute because of frequent postoperative recurrence of the ulcer Wangensteen s follow up studies have shown that the tubular resection is followed by too many recurrences to be a satisfactory operation Results of the segmental resection in his hands have been excellent

REFERENCES Wangensteen Connell

PLATE 54



SECTION 15

Other Operations for Complications of Ulcer

PERFORATION

PERFORATION OF AN ULCER of the duodenum is much more common than perforation of a gastric or jejunal ulcer. All are ushered in by the dramatic combination of severe epigastric pain followed by signs of peritonitis and shock. An x-ray taken in the erect position will demonstrate air beneath one or both diaphragms in about 40 per cent of patients six hours after the perforation.

On admission the patient with a suspected perforated ulcer has a Levin tube passed, the stomach is maintained empty by continuous suction. A mixture of penicillin 300 000 units and streptomycin 0.25 Gm is injected intramuscularly and the dose repeated every three hours. Sedatives are administered for pain. Intravenous fluids are given including large amounts of plasma. The student should consult Cope's series of papers describing the metabolic abnormalities of the patient and the preparation for operation.

Although some authorities believe that such a conservative regimen suffices for treatment of perforated ulcers, in the Massachusetts General Hospital operation is believed indicated as soon as the patient is in satisfactory condition. A patient should never be operated on until the stomach is empty or when in severe shock.

Type of operation.—The usual operation is a simple closure of the perforation. In recent years there has been a revival of interest in immediate gastric resection as the preferential method of treatment. Undoubtedly resection can be done safely when the perfora-

tion is less than six hours old when the patient is in good condition when a trained surgical team is present and when operating conditions are excellent Undoubtedly most perforated ulcers are not operated on under these circumstances In general terms immediate resection is reserved for the small groups of patients (1) who are operated on under optimal circumstances have a fresh perforation and have had ulcer symptoms previously (2) who have concomitant hemorrhage or obstruction from scar tissue (3) who have ulcers too large to close safely except by resection or (4) who have perforated gastric or anastomotic ulcers

Anesthesia.—These patients notoriously take anesthetics poorly During induction inhalation of vomitus may set up a virulent type of aspiration pneumonia uninfluenced by chemotherapy Hence the stomach must be emptied by Levin tube and kept on constant suction

Postoperative care.—The stomach is kept empty for 48 hours by continuous suction Then if the pylorus is widely open as demonstrated by presence of bile in the aspirate gravity drainage is substituted the nasal tube is usually removed four days after operation Antibiotics are continued in large dosage for about a week

Associated complications.—When perforation has occurred concomitantly with pyloric obstruction due to edema from an active ulcer the surgeon may obviate postoperative difficulties by doing a jejunostomy at time of suture of the perforation otherwise obstruction may reappear during convalescence Although this condition is most easily treated by a gastroenterostomy it must be recognized that with this procedure an anastomotic ulcer will probably occur later In patients who have a long standing cicatricial obstruction or in whom hemorrhage has occurred concomitantly with the perforation when operation is done early it is best to carry out gastric resection or at least to do the first stage of a two stage resection Massive hemorrhage may also occur during convalescence after suture of a perforation and occurring at that time carries a grave prognosis an emergency resection is usually best

Postoperative complications.—The common postoperative complications are (1) peritonitis or residual abscesses (2) pneumonia and (3) pyloric obstruction There should be few complications in these days of chemotherapy if proper attention is paid to the details of operation General peritonitis must be treated by complete Ochs

nerization Residual abscesses are commonest in the subdiaphragmatic areas and in the pelvis When pyloric obstruction is first noted postoperatively conservative therapy should be followed for about two weeks in the hope that the edema surrounding the suture will subside If unrelieved posterior gastroenterostomy supplemented by double jejunostomies or gastric resection may be done

Prognosis—If a resection has not been done patients with duodenal ulcers should be treated medically Patients with perforated gastric ulcers must be followed closely and should have a resection not over six weeks later if the ulcer is still present After a perforated anastomotic ulcer a resection or vagotomy should be considered as soon as possible because reperforation or hemorrhage is probable

Suture of Perforated Duodenal Ulcer

A—Operation must be preceded by aspiration of the stomach a Levin tube being left in situ The best incision is a right paramedian since it is readily extended if preoperative diagnosis is not correct

B—*The perforation usually is found on the anterior wall of the* duodenum immediately adjacent to the pylorus Rarely a double perforation is found hence adequate exploration is necessary in all cases A posterior perforation usually is walled off by the pancreas but it may burst into the lesser omental sac or the free peritoneal cavity A series of Lembert sutures is placed over the ulcer catching relatively normal tissue on either side of the ulcer

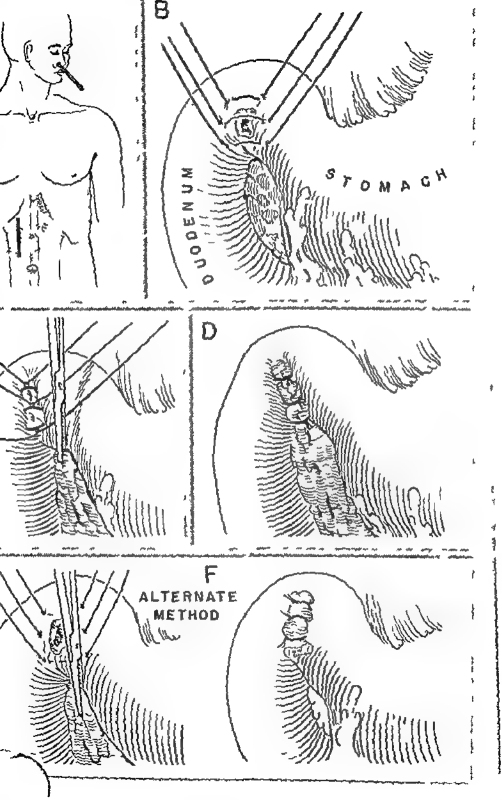
C—The sutures are tied closing the perforation It is usually impossible and unnecessary to use a second row However a tag of *omentum should be brought up to reinforce the suture*

D—Long ends of the original sutures are used to tie the omentum loosely in position

E—Occasionally there is so much induration that the Lembert sutures cannot be tied safely without either cutting through or obstructing the pylorus Under these circumstances a piece of omentum is brought over the perforation before the sutures are tied

F—The use of a free omental graft to cover the perforation is recommended as a routine by some surgeons However there seems no reason *to sever its* pedicle The free graft is reserved for the unusual case in which no other omentum is available

Finally the peritoneal cavity is aspirated thoroughly removing


B
STOMACH
DUODENUM
D
F
ALTERNATE METHOD

all gastric contents with particular attention being devoted to subdiaphragmatic spaces The abdomen is closed without drainage

Suture of Perforated Duodenal Ulcer with Obstruction

It is not uncommon for perforation to complicate an ulcer that has already produced pyloric obstruction Under these circumstances a simple suture is not sufficient The surgeon must then choose from several alternatives which include (1) immediate gastric resection a method reserved for early perforations with an apparently easy operation in a good risk patient (2) the first stage of two stage gastrectomy often the most satisfactory procedure (3) gastro-enterostomy practically always a poor operation under these circumstances since perforation implies an active ulcer and (4) jejunostomy which will tide the patient over the period of acute obstruction due to edema and will not interfere with an early resection if it becomes necessary

G—The duodenum has been closed as illustrated in Plate 55 *B–D* A jejunostomy has been performed according to the Stamm technic (Plate 70)

Suture of Perforated Gastric Ulcer

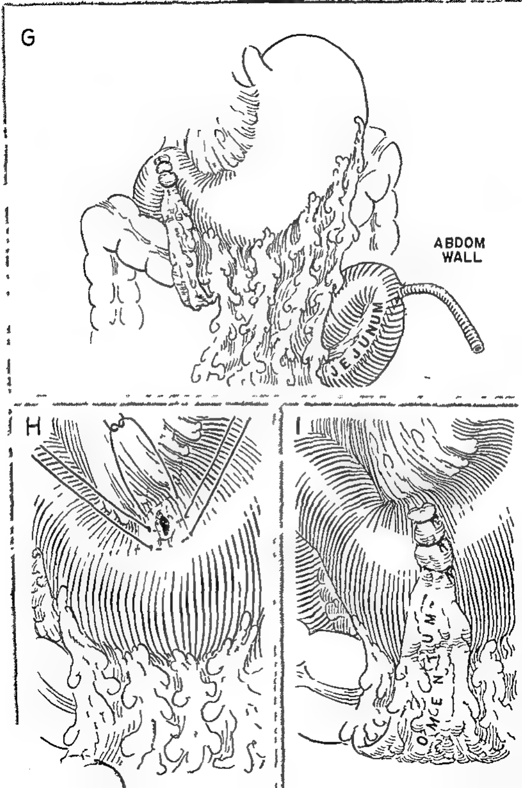
Most of the so called perforated gastric ulcers are actually duodenal ulcers located near the pylorus Perforations which are apparently near the pylorus are treated as duodenal ulcers When the perforation is along the lesser curvature and is only three to four hours old in a good risk patient a gastric resection should be carried out if operative conditions are satisfactory Otherwise generous biopsies may be taken from the wall of the ulcer before closure is begun Some huge perforations cannot be closed in any way short of a resection

H—The ulcer is excised as a biopsy specimen and the defect is closed by two layers of Lembert sutures

I—A second layer of interrupted sutures is placed tied and the ends left long With these a tag of omentum is tied loosely over the ulcer

Before closure the entire peritoneal cavity including the subdiaphragmatic spaces and lesser omental sacs is aspirated carefully

PLATE 55



Obstruction

Pyloric obstruction is a rather frequent complication of duodenal ulcer but is rare with gastric ulcer The presence of an ulcerating lesion of the stomach with pyloric obstruction is suggestive of gastric cancer and indicates early operation When the underlying lesion is duodenal ulcer obstruction may be due either to edema or to cicatricial obliteration of the duodenal lumen In the former, the patient usually has a good deal of pain from a concomitant active ulcer whereas in the latter pain is absent Operation should be avoided, if possible when the obstruction is due to edema but must be carried out when fibrosis is present

Choice of operation—For the few patients who must be operated on during the acute phase of an active ulcer some type of gastric resection is essential Since technical difficulties will make exposure of the duodenum hazardous, a two stage or Bancroft operation often is required Rarely a patient is so depleted that despite an active ulcer only a gastroenterostomy can be performed under these circumstances a resection should be planned within a few months since an anastomotic ulcer will form rapidly

When cicatricial obstruction is present operation should be performed as promptly as possible since gastric atony will follow delayed operation and the new stoma will function poorly The two operations that may be employed are gastroenterostomy and gastric resection

Gastroenterostomy is advised by many authorities when the patient is over 55 and the hydrochloric acid content of the stomach is low However return of gastric acidity after relief of obstruction as well as anastomotic ulcers are found not infrequently in older persons Less malfunction of the stoma seems to be encountered after resections than after simple gastroenterostomy Hence gastroenterostomy is restricted to the few patients who because of severe cardiovascular complications cannot stand more than a simple operation under procaine Particularly in elderly depleted patients it is well to carry out a double jejunostomy (Plate 70) at the same time to eliminate the dangers of stomal obstruction

Medical treatment—The management of a patient with acute obstruction involves great care and often a similar amount of diplomacy since both a physician and surgeon are usually involved A

definite time limit should be set at the outset, a week's trial of medical therapy is usually sufficient By then the obstruction either will have been relieved by conservative measures or surgery is undertaken

During the period of medical treatment the patient is treated chiefly by blood and electrolyte replacement Studies of blood chemistry will show a high nonprotein nitrogen and a low serum chloride level and alkalosis The serum sodium may be low and the intracellular potassium level is low even though the potassium in the serum is at a normal level Replacement is obtained by administration of normal saline solution to which potassium has been added Meanwhile the stomach is aspirated twice daily Aspiration is done in preference to continuous gastric suction since with intermittent aspiration some of the gastric contents may pass the pylorus Small amounts of milk may be allowed with Gelusil to counterbalance hydrochloric acid secretion Phenobarbital and antispasmodics are also given

There is no certain way to restore to normal an abnormal blood chemistry picture due to pyloric obstruction other than relief of the obstruction Hence when operation is carried out a simple feeding jejunostomy is not satisfactory The applicable operations of gastric resection and gastroenterostomy have already been described (Plates 45 and 36) However in depleted patients they should be supplemented by jejunostomy Through the jejunostomy tube an adequate amount of homogenized milk may be administered by constant drip as soon as patient regains peristalsis As Case and his associates have shown this is one type of feeding that is well tolerated without the diarrhea that accompanies many of the older jejunostomy mixtures

Hemorrhage

Operations are often necessary for the emergency control of massive upper gastrointestinal hemorrhages Though ulcer of some type or portal hypertension is the usual cause tumors gastritis and cirsoid aneurysms are other underlying lesions

Patients who enter the hospital with massive hemorrhage should be subjected to rapid diagnosis adequate blood replacement observation and in certain cases operation For surgery to be considered, there must be a good supply of blood an excellent anesthetist

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tion is common Postoperatively chemotherapy should be continued in full amounts and normal blood and electrolyte levels maintained by appropriate measures

MASSIVE HEMORRHAGE FROM OTHER SOURCES —In about two thirds of all cases of acute massive upper gastrointestinal hemorrhage in our hospital the underlying lesion is an ulcer In a quarter of the cases bleeding will be due to portal hypertension (*see* Section 23) In the rest a preoperative diagnosis is made only rarely but laparotomy is necessary for continuing hemorrhage

If at the time of exploration no evidence of ulcer or portal hypertension is found the small intestine first is examined carefully for any lesion If results of this examination are negative the stomach is opened by a long gastrotomy incision that is extended across the pylorus if necessary Retractors are inserted and the mucosa carefully inspected Usually the bleeding point will be disclosed and can be dealt with appropriately If there is widespread gastritis a high subtotal resection is carried out and the blood supply to the remaining fundus reduced by ligation of all but the ascending branch of the left gastric artery and by splenectomy This type of devascularization has been used successfully by Parker Mixter and Hinton have had success with high resection combined with vagotomy for bleeding from gastritis

surgeon and assistants Operation is indicated for those patients with definite or presumptive ulcer when bleeding fails to stop or recurs while under observation Most of these patients will be over 50

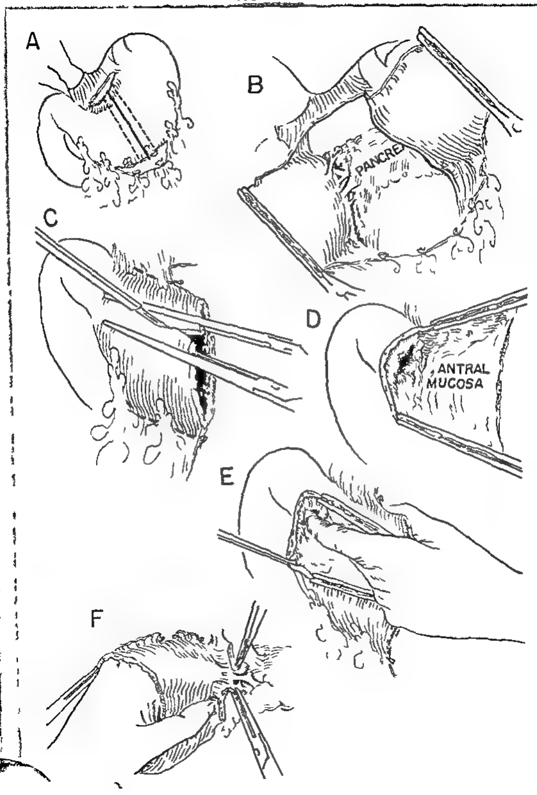
Preoperative treatment —An inlying nasal tube is placed and the stomach maintained as empty as possible during the first 24 hours by frequent irrigation with small amounts of normal saline solution The prothrombin time is checked and large doses (50–100 mg) of vitamin K administered if necessary If the prothrombin time should be high and there is no response vitamin K_1 oxide (Mephyton) is given Repeated transfusions running through two needles if necessary are given in an attempt to stabilize the hemoglobin at 10 Gm Antibiotics are begun before operation Early x ray examination by nonpalpation technic is done if the cause of the hemorrhage is not clear Complete blood studies are carried out

Choice of operation —If operation is necessary intratracheal anesthesia is used with two transfusions running At the present time cyclopropane is the agent of choice Ideally the operative procedure should secure complete hemostasis and render a cure of the underlying lesion In other words gastric resection including removal of the ulcer is best This occasionally may have to be modified by circumstances

If at laparotomy there is evidence of ulcer and the patient is not bleeding actively (i e no blood from the Levin tube and the upper jejunum empty of blood) resection may be done by any of the usual technics except that a determined attempt must be made to excise the ulcer since an excluded ulcer may bleed after operation

When active bleeding from a duodenal ulcer is encountered the feeding arterial vessels must be ligated in normal tissue if the gastroduodenal artery is involved it must be ligated above and below the ulcer With a gastric ulcer ligation of right and left gastric arteries with wedge excision of the ulcer will be enough to stop bleeding in the poor risk patient, but another gastric ulcer may form later

The exact operation that can be carried out must be determined by the individual surgeon Representative operations are illustrated in the following pages It is important to remember that this group of patients is prone to serious postoperative complications and therefore all measures possible must be taken to avoid them We usually use double jejunostomies in conjunction with resection for massive hemorrhage because the patients are depleted and stomal malfunc


A
B
PANCRE
C
D
ANTRAL MUCOSA
E
F

Gastric Resection for Acute Massive Hemorrhage
Allen's Method

Operations for massive hemorrhage necessarily will vary greatly because of the different arteries that are involved in the ulceration The procedure described here is valuable when there is profuse active bleeding from the gastroduodenal artery at the base of a duodenal ulcer

A—A small area along both curvatures of the stomach is cleared rapidly and Payr clamps applied to divide the stomach

B—The distal stomach is elevated demonstrating inflammatory adhesions along the posterior wall of the stomach at the pylorus

C—The lower Payr clamp is removed Two long Kocher hemostats are applied on the anterior wall of the stomach, extending from the cut edge of the stomach to the pylorus With the scalpel the stomach is divided between the clamps

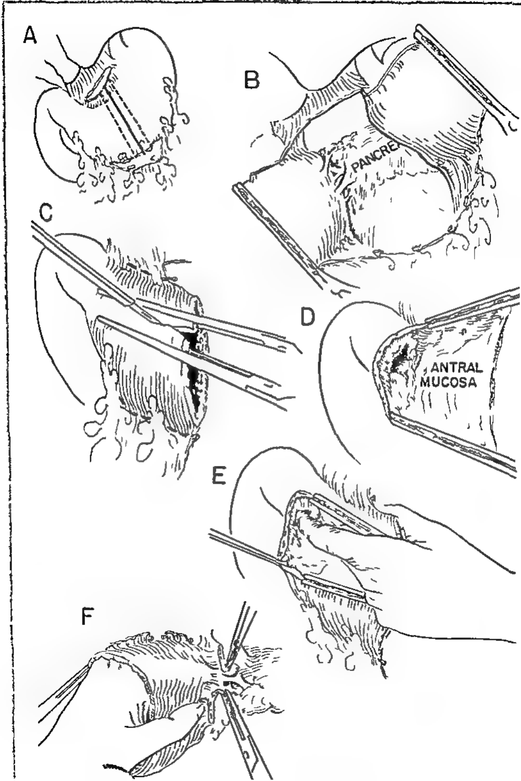
D—The ulceration with thrombi in the upper and lower segments of the gastroduodenal artery is now visible When the thrombus is fresh it is easily dislodged by this dissection and alarming hemorrhage may begin at any time

E—The surgeon's left index finger is placed in the duodenum and with digital tamponade the bleeding is controlled entirely All the preceding steps are carried out rapidly so there is actually little blood loss before the surgeon can control the bleeding

F—A more leisurely dissection can now be carried out By turning the stomach to the patient's right the posterior dissection down to the region of the gastroduodenal artery is completed

[Resection for hemorrhage *continued on page 236*]

PLATE 56



G—It is now necessary to tie the gastroduodenal artery above and below the ulcer bed in comparatively normal tissue Stitch ligatures through the base of the ulcer are not adequate Since the gastroduodenal artery is often buried in inflammatory tissue, control may not be possible by clamps as shown here and stitch ligatures may be necessary With the bleeding stopped the duodenum is mobilized beyond the ulcer bed and excess stomach and duodenum removed

H—*Final control of the hemorrhage is achieved when the distal* end of the gastroduodenal artery or its terminal branches the gastroepiploic and superior pancreaticoduodenal are tied outside the ulcer bed It should be noted that stitch ligatures when required for the control of hemorrhage must be placed no deeper than necessary because of the danger of wounding the common duct The insert shows the anatomical sites of various ligatures

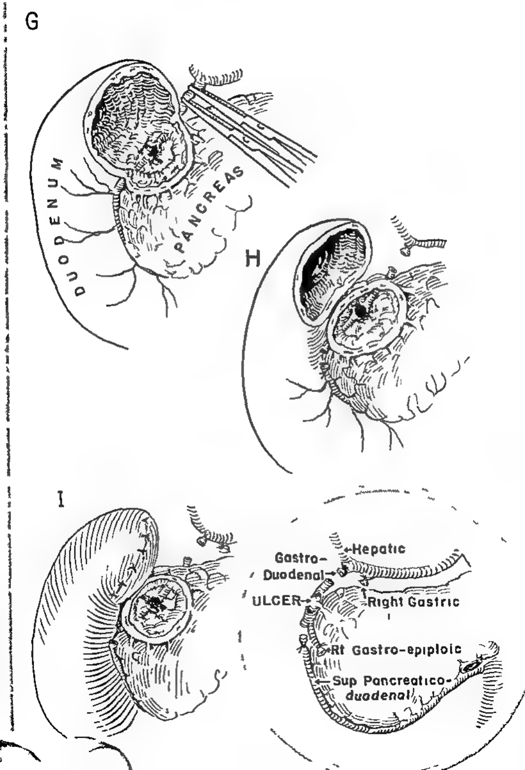
I—The duodenum is now closed with three layers of sutures The ulcer bed is seen to be excluded from the gastrointestinal tract and is left open

Attention is then directed to the proximal stomach An adequate resection is carried out and a gastrojejunostomy performed

It need not be assumed that the hemorrhage arises from the gastroduodenal artery in all cases of bleeding duodenal ulcer Indeed bleeding is far more common from one of the smaller branches of the gastroduodenal than from the main trunk Under these circumstances the technical control of the bleeding vessel is much simpler It is only when the lateral wall of the gastroduodenal artery has been eroded by the ulcer that the particular ligatures shown on this plate are required

A useful modification of this operation may be carried out when the ulcer seems too large or too low to warrant resection The duodenum is *opened Control of hemorrhage is secured* as shown but as much duodenum as possible is left and the ulcer bed not disturbed A catheter duodenostomy is then performed as shown in Plate 53

REFERENCE Allen


G
DUODENUM
PANCREAS
H
I
Hepatic
Gastro-
Duodenal
ULCER
Right Gastric
Rt Gastro-epiploic
Sup Pancreatico-
duodenal

Wedge Excision of Gastric Ulcer

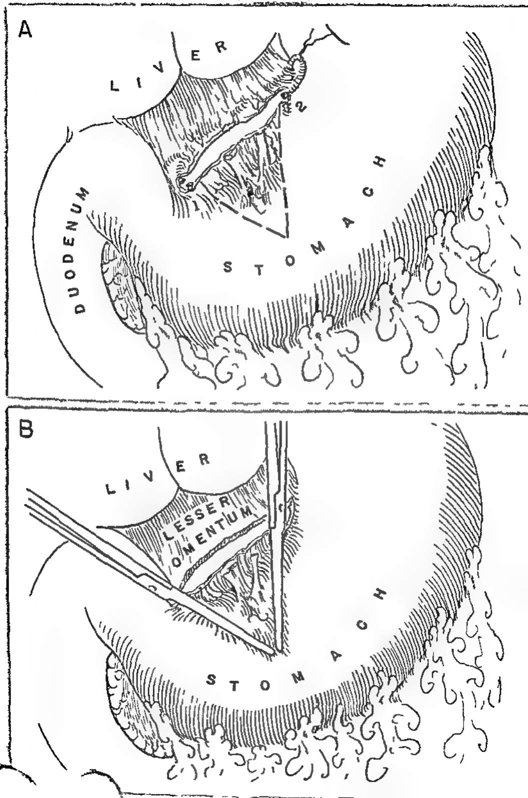
A bleeding gastric ulcer may be controlled, generally speaking more easily than hemorrhage from a duodenal ulcer For this reason in poor risk patients a less formidable procedure than gastric resection can be carried out A local excision of the ulcer by the removal of a wedge from the lesser curvature is particularly applicable Some surgeons still use this method of surgical treatment as the one of choice for all gastric ulcers combining it with a gastroenterostomy or pyloroplasty In our hospital it has no place except as an operation of expediency for massive hemorrhage

A —The lesser omentum has been divided adjacent to the ulcer It may be necessary to cut inflammatory adhesions to the pancreas The ulcer is to be excised through normal tissue along the dotted lines The right gastric artery must be secured at point *1*, and the left gastric at 2

B —Kocher clamps are applied along the dotted lines seizing both the anterior and posterior walls of the stomach The section of stomach including the ulcer is now excised with the scalpel The specimen should be opened and inspected immediately If a definite bleeding point can be seen at the base of the ulcer and the lesion apparently is benign the closure of the defect may be started If no open vessel can be observed in the ulcer it is best to remove the clamps insert small retractors into the stomach and elevate the anterior wall to look for other bleeding points It must be recalled that multiple gastric ulcers are not rare and the hemorrhage may arise from a less obvious lesion

[Wedge excision of ulcer *continued on page 240*]

PLATE 57



C—The clamps are now removed Traction sutures are placed at the lower angle of the wedge on the anterior wall (3) and on the posterior wall (4) With slight tension 3 and 4 are pulled apart producing a linear defect extending across the lesser curvature Meanwhile any gastric secretions are picked up with the sucker

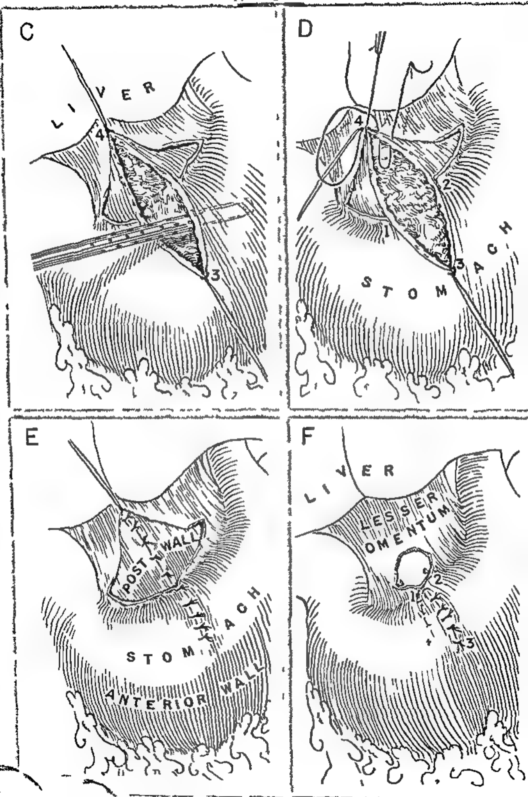
D—All active mucosal bleeders in the margins of the cut stomach are ligated Retractors are introduced the margins of the stomach elevated and the mucosa inspected carefully to rule out any other site of hemorrhage Then closure is begun with a 00 catgut continuous Connell suture

E—The closure is completed by a second layer of interrupted nonabsorbable sutures

F—The traction sutures have been cut allowing the stomach to assume a normal position

In other instances control of bleeding gastric ulcers will tax the ingenuity of the surgeon One particularly troublesome type is the ulcer high on the lesser curvature Here some surgeons have used a transthoracic approach—one that should be criticized on the basis that the opening and closure of the incision is too great a procedure in a severely depleted patient It is better to accept a somewhat poorer exposure through the abdomen that can be made rapidly If the condition of the patient will not permit resection the left gastric artery can be divided near its origin the vessels along the curvature controlled by suture ligatures above and below the ulcer and if necessary the ulcer exposed by a gastrotomy incision and bleeding controlled by intragastric plicating sutures

PLATE 57


C
LIVER
4
3
D
4
1
2
3
STOMACH
E
POST WALL
STOMACH
ANTERIOR WALL
F
LIVER
LESSER OMENTUM
1
2
3

[242] *Resection for Exclusion*

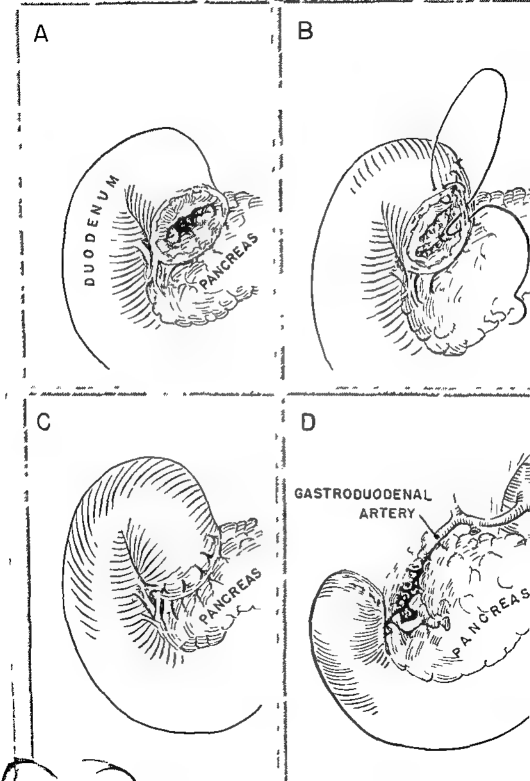
Gastric resection with exclusion of a duodenal ulcer is a perfectly good operation for intractable or obstructing ulcers Used as the operation of choice for acute massive hemorrhage it is open to serious criticism Nevertheless it is used by many surgeons when no active bleeding is found at operation and removal of the ulcer appears to be too hazardous

A—The duodenum has been divided just distal to the pylorus No clamp has been applied in order that all possible length of duodenum can be used for the closure The ulcer is seen overlying the gastroduodenal artery but no bleeding is visible

B—Stewart has advised packing the ulcer bed with Gelfoam numerous squares being applied Closure of the duodenum is begun with a 000 running Connell suture

C—The closure of the duodenum is completed in three layers in the usual manner

D—If hemorrhage has occurred from the main branch of the gastroduodenal artery recurrent hemorrhage after an exclusion operation is not uncommon This has occurred in our experience from 24 hours to two weeks after the original procedure If it occurs it is absolutely incumbent on the surgeon to reoperate and to perform actual ligation of the gastroduodenal artery


A
B
C
D
DUODENUM
PANCREAS
PANCREAS
PANCREAS
GASTRODUODENAL ARTERY
PANCREAS

SECTION 16

Gastric Cancer

Choice of Operation

When all patients with cancer of the stomach are considered, the treatment chosen will fall into one of three categories: either no operation, a palliative procedure or a resection for cure.

Inoperable cancer.—About 25 per cent of the patients are hospitalized with disease so far advanced that operation of any kind is useless. This group includes patients with multiple distant metastases such as those in the cervical lymph nodes or lungs, and patients with extensive hepatic metastases or carcinomatosis of the peritoneal cavity, indicated either by ascites or metastases in the pouch of Douglas. Even in these patients a biopsy to confirm diagnosis should ordinarily be made by excision of a lymph node or by peritoneoscopy, and it must not be forgotten that resection of an isolated distal metastasis and a gastric resection have at times produced five year survival.

Large palpable tumors, even in older patients, do not contraindicate operation, since an occasional five year survival has resulted even in this group.

Palliative procedures.—There are several types of palliative procedures designed particularly to relieve the nausea and vomiting that accompany pyloric obstruction. The best palliative operation is a gastric resection. Comfortable respite of a year or two may often result even though irremovable nodes or hepatic metastases are encountered at operation. If the cancer involves the distal stomach and is so fixed to the pancreas that it cannot be resected, an exclusion procedure is best and can be used when normal stomach is found above the tumor. Unfortunately, however, the cancer frequently

involves so much of the stomach that only a gastroenterostomy is possible When the cardia and esophageal orifice are involved non resectable cancers may be treated by gastrostomy or by palliative anastomoses about the cardia Permanent jejunostomies are not worth while

OPERATIONS FOR CURE —The usual operations for cure of cancer of the stomach are subtotal and total gastrectomy The relative merits of the two methods are still the subject of debate There is no question but that total gastrectomy should be done much more frequently than it has been in the past and there is no reason to be content with a subtotal gastrectomy in which there is a margin of less than 5 cm above a gastric cancer The disadvantages of total gastrectomy are the high incidence of postoperative complications and a higher mortality rate and more common occurrence of rather severe states of malnutrition compared with subtotal resection

A number of more radical operations have been proposed for cancer of the stomach Dissection of the nodes along the hepatic artery and celiac vein distal pancreatectomy and splenectomy may be combined with either partial or total gastrectomy More extensive resections have been described but their value is questionable

Spindle cell tumors comprise less than 5 per cent of gastric neoplasms They include fibromas neurofibromas leiomyomas and their malignant variants Despite a histological diagnosis of sarcoma most of these tumors remain localized to the stomach for long periods Massive hemorrhage is a common presenting symptom Operations for these tumors include local excision partial proximal or distal gastric resection and rarely a sleeve resection followed by gastrogastrostomy The regional lymph nodes should be excised although nodal metastasis is rare These tumors are particularly common in the fundus of the stomach

Lymphosarcoma of the stomach may produce a bulky tumor that involves other adjacent organs With malignant lymphoma there is usually diffuse rather soft thickening of the gastric wall with superficial ulcerations of the mucosa Radical resection followed by x ray therapy is indicated

REFERENCES McNeer· Allen *et al.* (on lymphoma)

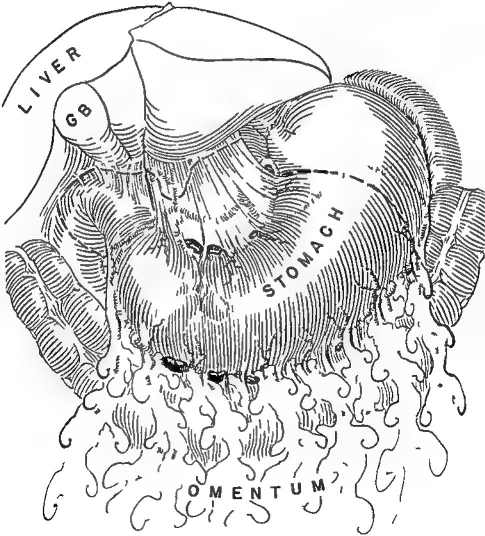
Subtotal distal resection is used for grossly benign gastric ulcer for spindle cell tumors of the distal stomach and for apparently curable gastric cancer provided the surgeon can resect 5 cm of normal stomach above the tumor Palliative subtotal gastrectomy is indicated in the presence of hepatic peritoneal or extensive irremovable lymph node metastases since it will spare the patient much of the nausea and vomiting that accompany the terminal stages when the stomach is obstructed by tumor

A —The anatomical limits of the resection are shown for a carcinoma arising in the antrum of the stomach The stomach is divided just below the level of the esophagus The duodenum is sectioned at least 2 cm beyond the pylorus and even farther if tumor extends to the pylorus The greater and lesser omenta are removed The left gastric right gastric and right gastroepiploic arteries are all ligated near their sources The following groups of lymph nodes are removed left gastric right gastric gastroepiploic and subpyloric The resection is to be performed en bloc

Sections of adjacent organs if involved with cancer must be removed with as wide a margin of normal tissue about the tumor as is compatible with safety The transverse colon and pancreas are involved most commonly Since resections of the colon are required so frequently with cancer of the stomach it is well to devote special attention to the preoperative preparation of the bowel by enemas and chemotherapeutic measures When a portion of the colon is resected end to end anastomosis is carried out particular care being used to obtain an adequate blood supply to the anastomosed bowel since the middle colic artery is often sacrificed this may mean wide mobilization of the hepatic or splenic flexures If the tail of the pancreas is resected a drain should be placed near the cut end at conclusion of the operation or retroperitoneal tissues drawn over the suture line A section of the left lobe of the liver may be adherent to or be involved by cancer and require resection The spleen is not involved often by cancer but can be removed to secure more adequate node dissection Splenectomy combined with partial pancreatectomy will remove all the splenic nodes If splenectomy is done as well as ligation of the left gastric artery at its source the stomach remnant may be devitalized and a total gastrectomy may become necessary

[Subtotal distal resection *continued on page 248*]

A



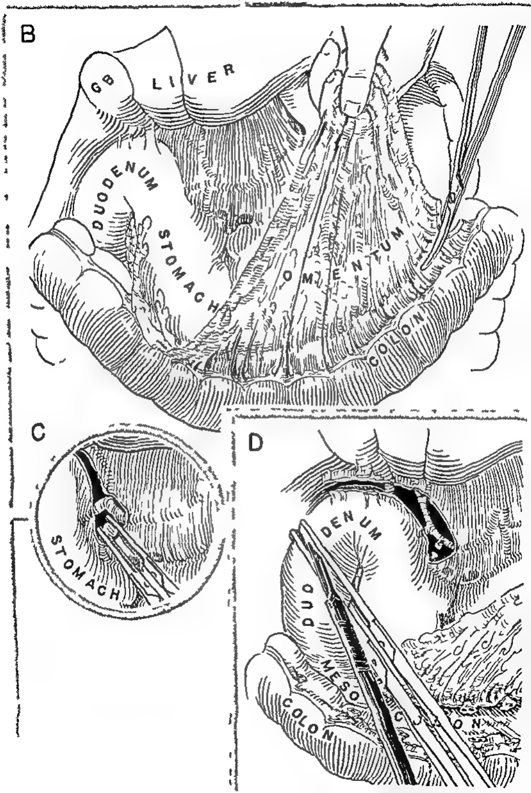
B.—The omentum is separated from the colon as the first step Theoretically this dissection is in a bloodless plane but it will be found especially in obese patients that numerous adhesions and collateral vessels make this a rather difficult procedure When the surgeon stands on the left side of the table it is usually easiest to start from the left side separating the omentum from the colon with the scissors As the dissection is carried to the patient's right adhesions to the transverse mesocolon must be separated and care must be taken not to traumatize the midcolic vessels When the duodenum is resected the right gastroepiploic artery is divided just distal to its origin It is best to use three clamps on this vessel so that the proximal end may be doubly ligated

C.—The hepatoduodenal ligament is now divided exposing the right gastric artery This small vessel is divided between Kelley hemostats and ligated

D.—With a freely mobile duodenum it now is usually easy to pass the left index finger behind the duodenum Allen clamps are then applied and the duodenum divided with the scalpel Note that the clamps are placed at least 2 cm beyond the pylorus Thereafter it may be necessary to divide a few small blood vessels leading to the duodenum to secure the requisite 2 cm needed for the turn in of the stump

It will be noted that this type of resection for gastric ulcer or cancer varies from that described for duodenal ulcer since here the resection is begun in the duodenum rather than at the upper portion of the stomach In many cases however a prepyloric lesion will be found surrounded by much inflammation and it will be best to start the dissection from above The surgeon always should apply the principle that dissection begins in the easiest location and progresses to the most difficult

[Subtotal distal resection *continued on page 250*.]


B
GB
LIVER
DUODENUM
STOMACH
OMENTUM
COLON
C
STOMACH
D
DUO
DENUM
MESO
COLON
COLON

E—A small strip of gauze is now tied over the proximal clamp and the stomach is retracted to the left The duodenal stump is now closed This is usually done by the method shown in Plate 45 However the method of open closure will be illustrated here

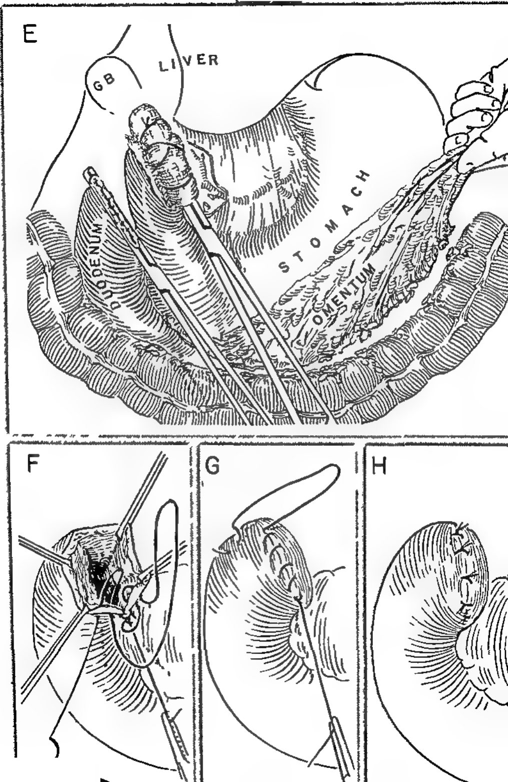
F—An open closure of the duodenum is done when inspection of the open duodenum is necessary as for example with massive hemorrhage or if the mobilized portion of the duodenum is quite short Here the open duodenum has been caught by Allis clamps An inverting Connell suture is started at the greater curvature

G—The duodenum is closed by the first row of sutures The same 00 nontraumatic suture is now continued as a semi purse string on the lesser curvature and then carried back as a second row that inverts the first as shown in Plate 50

H—A third layer of interrupted sutures has been applied to complete the closure

[Subtotal distal resection *continued on page 252*]

PLATE 59



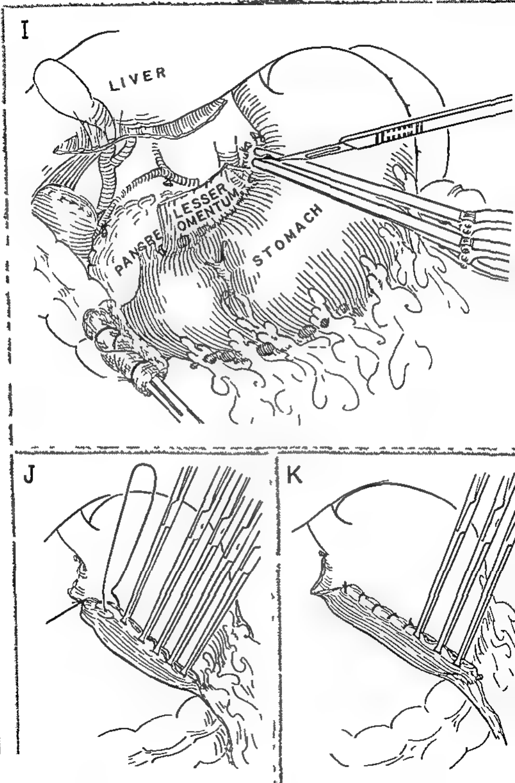
I—The lesser omentum to be removed with the stomach is freed completely from the liver The distal end of the stomach is then brought sharply anteriorly to demonstrate the left gastric artery which can be grasped with three hemostats just distal to its origin divided and doubly tied on the proximal side Payr clamps are applied and the stomach divided just below the esophagus The specimen is opened and examined by the pathologist and frozen sections made if necessary The margin of normal stomach above a definite carcinoma should be at least 5 cm

The gastrojejunostomy now is made Usually an antecolic Hofmeister anastomosis is performed for cancer on the basis that such an anastomosis will not be involved as rapidly as a retrocolic if recurrent disease develops in the region of the head of the pancreas or celiac axis Also when operating for cancer there is no danger from an enteroenterostomy This procedure is usually done particularly when the afferent loop is long The antecolic Hofmeister anastomosis will be described

J—The Payr clamp has been removed and replaced by a row of Allis forceps that catch both walls of the stomach reducing contamination and bleeding These clamps are removed one by one as the suture progresses downward The upper half of the cut end of stomach is to be closed A 00 nontraumatic catgut suture is started just above the cut margin and tied It is then carried down as a running suture catching both anterior and posterior margins of the stomach in the area previously crushed by the Payr clamp

K—The suture is run down a sufficient distance to allow a stoma about 5 cm long It is then tied

[Subtotal distal resection *continued on page 254*]


I
LIVER
LESSER
OMENTUM
STOMACH
PANCRE
J
K

L.—The running suture is inverted by a row of nonabsorbable Lembert sutures. A loop of proximal jejunum is then brought anterior to the colon with the afferent loop to the lesser curvature. This loop need not be short if an enteroenterostomy is to be made. It is sewed to the stomach with a series of nonabsorbable sutures that run from the stomach (about 1 cm. below the cut end) to the jejunum. Note that the anastomosis is to lie exactly on the antimesenteric border (*1–2*) and the row of sutures lies 1 cm. posterior to that line. The jejunum is anchored to the stomach wall by several sutures above the anastomosis.

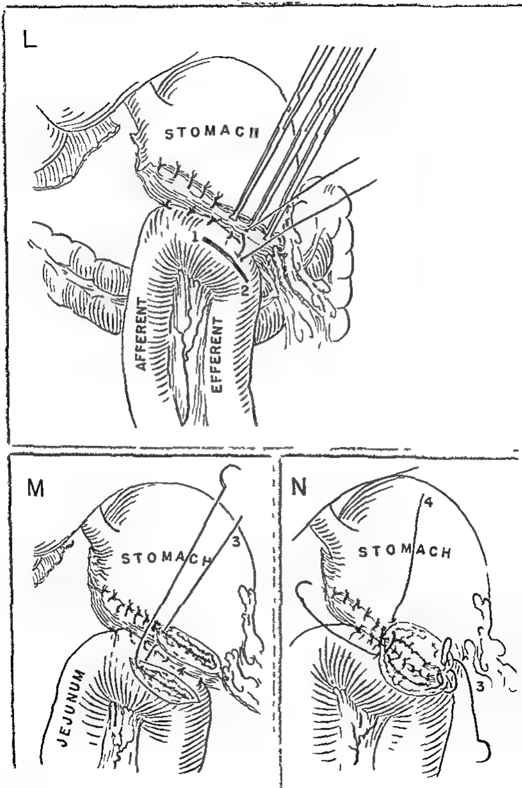
M.—The jejunum is opened with scissors along the line *1–2* and any active bleeders seized with fine hemostats and ligated with 000 catgut. The remaining clamps are then removed from the stomach and the gastric walls separated. The inner posterior layer of 00 chromic catgut (*3*) is being placed.

N.—The inner posterior row has been continued about the lower angle as a Connell suture. The inner anterior layer is now started from the upper angle (*4*) and continued down to meet the previous suture (*3*). Then two ends are tied, completing the inner row.

At this point it seems wise to re-emphasize some of the important technical features of this anastomosis, since in a poorly constructed stoma obstruction often develops postoperatively. Hemostasis must be complete, and frequently ligation of several mucosal vessels is necessary. All running sutures must be placed accurately on the mucosa; if allowed to track haphazardly, the mucosa will not lie smoothly at the end of operation. Connell sutures must be delicate and must not invert too much mucous membrane. If the jejunum is small, it is better to use a simple running suture on the anterior row. All blood vessels must be studiously avoided, for trauma by the needle will produce troublesome hematomas. Interrupted sutures in both rows are used by some surgeons; if they are used, hemostasis must be meticulous.

[Subtotal distal resection *continued on page 256*.]

PLATE 59


L
STOMACH
1
2
AFFERENT
EFFERENT
M
STOMACH
3
JEJUNUM
N
STOMACH
4
3

L.—The running suture is inverted by a row of nonabsorbable Lembert sutures. A loop of proximal jejunum is then brought anterior to the colon with the afferent loop to the lesser curvature. This loop need not be short if an enteroenterostomy is to be made. It is sewed to the stomach with a series of nonabsorbable sutures that run from the stomach (about 1 cm. below the cut end) to the jejunum. Note that the anastomosis is to lie exactly on the antimesenteric border (*1–2*) and the row of sutures lies 1 cm. posterior to that line. The jejunum is anchored to the stomach wall by several sutures above the anastomosis.

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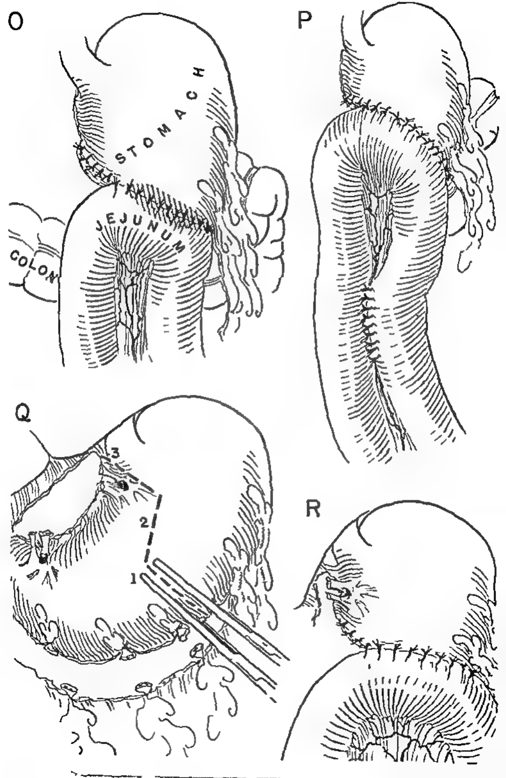
[Subtotal distal resection *continued on page 256*.]


O
STOMACH
JEJUNUM
COLON
P
Q
3
2
1
R

O —The anastomosis is completed by an anterior outer row of interrupted Lembert sutures of cotton or silk

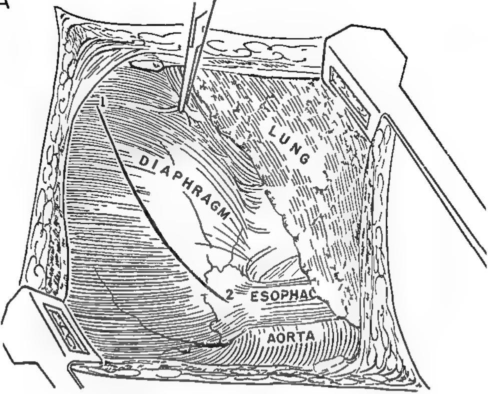
P —As an optional procedure when the operation has been done for cancer the surgeon may add an enteroenterostomy between the afferent and efferent jejunal loops If the lesion apparently was a benign gastric ulcer enteroanastomosis is avoided When used it should be placed in such a position that tension on or torsion of the bowel is avoided It should be about 4 cm in length This anastomosis is made in the same way as the gastrojejunal anastomosis e g by the open method with an inner layer of continuous catgut and an outer layer of interrupted cotton or silk

The choice of surgical therapy for the ulcer high on the lesser curvature and apparently benign is difficult Unless the lesion is almost surely benign proximal gastrectomy is to be preferred Occasionally the presence of an active duodenal ulcer may make the surgeon certain he is dealing with a benign lesion or for other reasons he may not wish to carry out as extensive an operation One of the following procedures then can be done

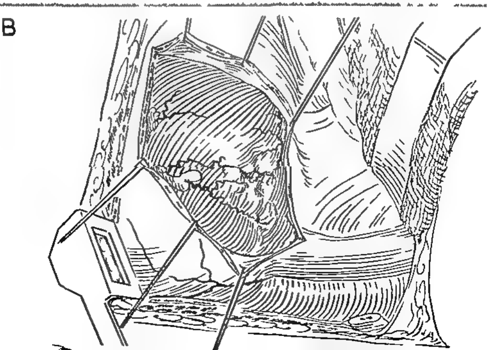
Q —The ulcer high on the lesser curvature will be resected with a narrow margin around it conserving more of the greater curvature for the anastomosis In this step of the resection three pairs of Kocher clamps are applied along the line of section shown in the figure The lowest pair of clamps is applied (*1*) and the stomach cut between them The cut margins are then separated slightly and the second row of clamps applied at a more oblique angle (*2*) The third pair finally grasps the lesser curvature just above the ulcer (*3*) After resection of the distal stomach the upper portion of the cut margin is closed and the lower part used for any type of anastomosis desired Care must be taken to avoid constriction of the cardia on closure A similar resection may be performed with specially curved gastric clamps of the Schoemaker type Immediate examination of the specimen by the pathologist is advisable

R —*Madlener operation* —A high gastric ulcer presumably benign has been left in situ while the distal stomach has been resected and a gastrojejunostomy done This operation as mentioned previously has definite shortcomings but it will result in the healing of high gastric or esophageal ulcers If it is done intragastric biopsies should be secured from the wall and base of the ulcer

A



B



The operation of cardiectomy may be performed by either the transthoracic or transabdominal route. It is indicated particularly for spindle cell tumors of the cardia, high benign gastric ulcers and some gastric carcinomas that are sharply localized. In many instances the surgeon must be prepared to excise a portion of the lower esophagus if disease extends to the upper margin of the stomach. This cannot be accomplished satisfactorily by an abdominal approach. Hence if preoperative studies indicate that cancer is present and extends to the upper margin of the stomach, a transthoracic or abdominothoracic incision is best. In this series the transthoracic approach is illustrated.

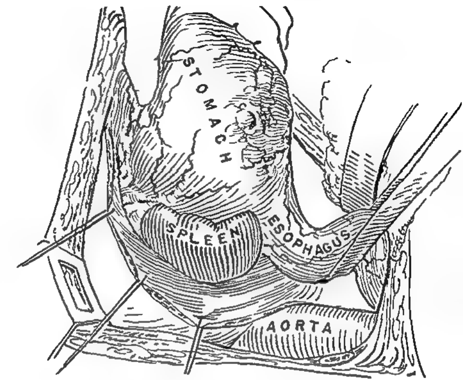
A.—The left chest has been opened through the bed of the ninth rib (Plate 10). The phrenic nerve is crushed. The diaphragm will be opened along the line 1–2 directly parallel to the resected rib and extending to the esophageal hiatus. For purposes of orientation, the gauze packs that cover the wound edges are omitted on the sketches.

B.—The diaphragm is now opened. The central tendon is first elevated with forceps and an incision made into the peritoneal cavity. The incision is extended sufficiently to allow insertion of a hand so that the resectability of the lesion can be assessed. If the lesion is operable, the diaphragm is opened widely. The left index finger is inserted between the diaphragm and esophagus, and the hiatus opened over it. Bleeders in the diaphragm are tied with silk stitch ligatures, particular attention being devoted to a branch of the left inferior phrenic artery just anterior to the hiatus. The diaphragm is then retracted by a series of traction sutures.

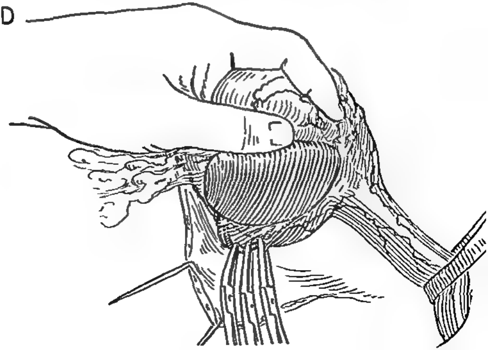
[Proximal partial resection *continued on page 260*.]

PLATE 60

C



D



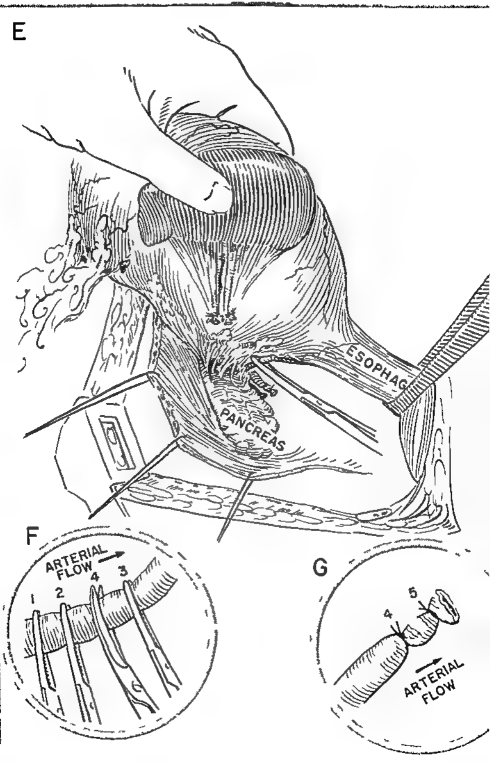
C—Adhesions of the spleen to the diaphragm are cut, and the spleen and stomach gradually elevated Although removal of the normal spleen introduces additional hazard to the operation, since the postoperative complication of portal vein thrombosis may be induced the spleen must be removed if the resection is for actual or suspected cancer Only in this way can the splenic nodes be excised, and they may be the first ones to be involved in a carcinoma of the cardia To elevate the stomach it is necessary to separate the great omentum from the distal transverse colon The omentum is to be removed with the stomach down to the point of division of the stomach The esophagus is then mobilized after the mediastinal pleura over it is incised in a line parallel to the course of the esophagus The fingers of the left hand are passed about the esophagus and the lower 5–7 cm freed A few small segmental arteries arising from the aorta may require ligature A traction tape is then passed about the esophagus Excessive manipulation or mobilization of the esophagus is avoided but the surgeon should plan to remove 5 cm above the palpable tumor

D—The stomach is now elevated and retracted toward the patient's right The tail of the pancreas is dissected from the hilum of the spleen assuming that it is not involved by cancer However in this location the pancreas is often densely adherent to the stomach cancer and the distal half or third must be sacrificed When involved it is divided with the scalpel and the cut end closed by interrupted cotton or silk sutures The splenic vessels are interrupted along the upper border of the pancreas as near to the origin of the artery as possible

Addition of a routine partial pancreatectomy to this operation has certain advantages and adds some hazards In favor are the wider dissection of lymph nodes and since the splenic vein is ligated close to the junction with the inferior mesenteric the reduced chance of splenic vein thrombosis and infarcts of the liver On the other hand any section of the pancreas may result in leakage of pancreatic juice with its attendant dangers It seems reasonable to do a partial pancreatectomy only if the lesion is definitely malignant and nodes are palpable that could be removed by this addition to the operation

[Proximal partial resection *continued on page 262*]

PLATE 60

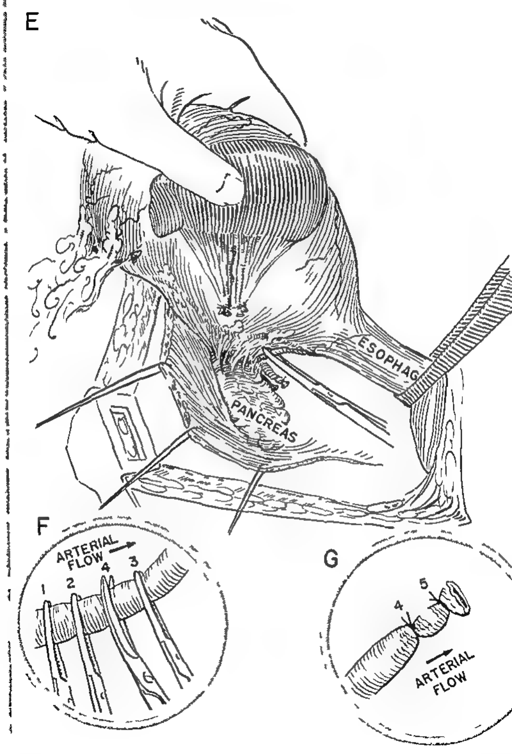


E—Further mobilization of the stomach now requires section of the left gastric vessels The stomach and spleen are elevated strongly demonstrating the left gastric artery as it ascends from the celiac axis to the lesser curvature of the stomach Before applying hemostats the surgeon should first palpate the hepatic artery accurately so that it will not be damaged The left gastric vessels are then clamped

F—At the risk of introducing material that may insult the read ers intelligence a word must be said about the ligation of the splenic left gastric or other large arteries A poor ligature in this position has resulted in death of patients before resuscitation was possible The less fat there is about a vessel the more likely is the tie to hold Consequently when feasible these vessels are ligated individually Often time does not permit their accurate isolation and then a mass ligature is necessary For ligation of a vessel three Kelley clamps are applied *1* and *2* to the proximal side of the vessel and *3* to the distal side The vessel is then cut with scissors *4* The first tie on the proximal vessel is of #1 chromic catgut and is set in the groove produced by clamp *1* as it is removed While the first knot is being set hemostat *2* is opened and then reclamped so that the tie may secure complete compression A second stitch ligature is then placed beneath hemostat *2* and tied as the instrument is removed

G—Even when the artery can be isolated and is free from ad ventitious tissue it should be ligated doubly with a tie (*4*) and a stitch ligature (*5*) distal to it Finally when the artery is so short that only one clamp can be applied and a single ligature has to be used this should be a strong suture ligature

[Proximal partial resection *continued on page 264*]


E
ESOPHAG
PANCREAS
F
ARTERIAL FLOW
1
2
4
3
G
5
4
ARTERIAL FLOW

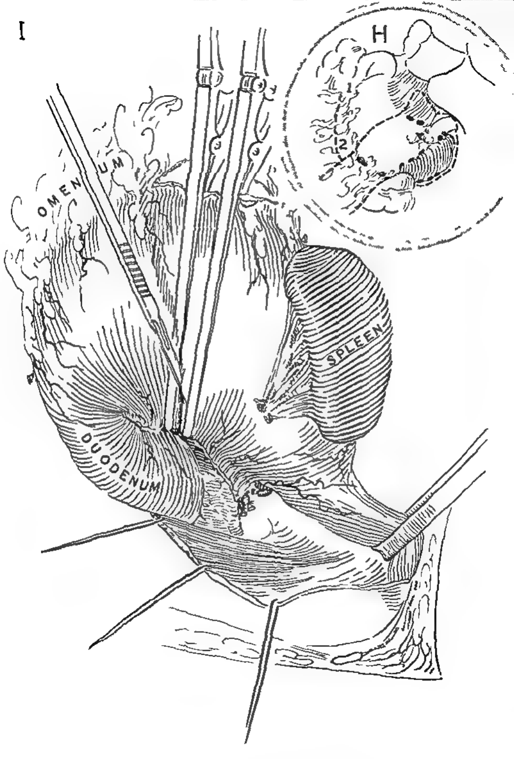
A *decision now must be made as to whether a subtotal or total* gastrectomy is indicated A subtotal resection is done when (1) the lesion grossly is cancer no lymph node metastases are encountered and a margin of 5 cm of normal stomach can be obtained below the tumor (2) the lesion is definitely cancer and locally operable but irremovable metastasis makes the resection a palliative one, (3) the lesion is apparently a benign ulcer (4) the lesion is a spindle cell tumor

H —The insert shows the anatomical extent of the subtotal resection The spleen, the greater omentum adjacent to the upper portion of the greater curvature and the upper portion of the lesser omentum are to be removed together with the upper portion of the stomach and the lower portion of the esophagus Three sets of lymph nodes are included in the dissection—the left gastric the splenic and the periesophageal

To nourish the distal stomach the right gastroepiploic and right gastric arteries must be left intact To attain adequate mobility of the stomach the omentum is divided just below the gastroepiploic vessels from the line of resection to the pylorus (line *1–2*) Small bites and fine ligatures must be used in this dissection Further mobility may be obtained by freeing any adhesions about the duodenum

I —The stomach is now elevated from the wound and after application of clamps divided with a scalpel In this illustration for the sake of orientation the duodenum is shown pulled out much farther than is usually possible The transverse colon has been returned to the peritoneal cavity The pancreas is shown in the base of the wound with the ligated splenic vessels just above it

[Proximal partial resection *continued on page 266*]


I
H
1
2
3
OMENTUM
SPLEEN
DUODENUM

J—A strip of gauze is now tied over the cut end of the proximal stomach The level at which the esophagus is to be divided is determined next If no tumor is palpable in the esophagus and the lesion is potentially curable carcinoma 3–5 cm is removed For palliative resections probable benign gastric ulcers or spindle cell tumors, less esophagus need be removed

Guy ligatures are placed in the esophagus about 1 cm above the projected line of division The Levin tube is withdrawn by the anesthetist to a point just above the guy ligatures A right angle clamp is then placed across the esophagus distal to the line of section and with suction being applied to the Levin tube the esophagus is transected with the scalpel Note that the esophagus proximal to the line of section must not be traumatized by clamps

The specimen is now given to the pathologist for immediate examination If the margin is not adequate further resection of esophagus or distal stomach must be done Frozen sections are not too helpful instead, the surgeon must depend on the gross appearance removing at least 5 cm above the gross tumor

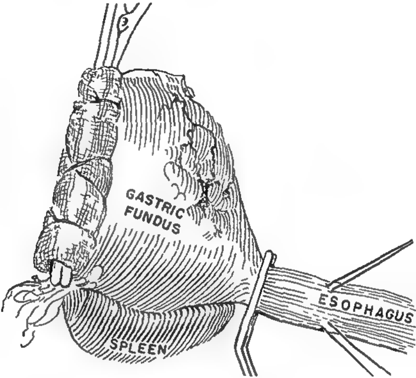
K—The distal end of the stomach is now turned in with two layers of sutures The first layer is of continuous 00 catgut and is a simple running or Connell suture

L—A second layer of sutures of interrupted cotton or silk of the Lembert type completes the closure It is important to avoid the turn in of unnecessarily wide areas of gastric wall since this will shorten the gastric remnant

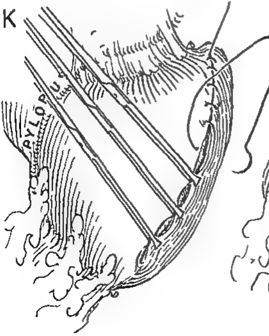
The reader may wonder why an anastomosis of the esophagus to the upper margin of the cut end of the distal stomach is not used in preference to squandering a certain length of stomach with this turn in The reason is of course that the blood supply of the esophagogastric anastomosis will be better if the anastomosis is made in the manner illustrated Furthermore an anastomosis using the cut end of stomach is not likely to be satisfactory technically since there is a weak spot where the lower angle of esophagus and anterior and posterior walls of the stomach are sutured

[Proximal partial resection *continued on page 268*]

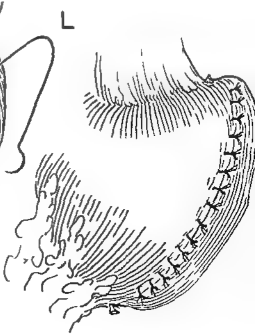
J



K



L



The esophagogastrostomy is now done Implantation of the esophagus into the cut end of the stomach has been found to be less satisfactory than Sweet s method which is illustrated here

M —The portion of the stomach that can most easily be elevated to the esophagus is usually the anterior wall near the greater curvature About 1 5 cm below the gastric suture line, a circular incision slightly smaller than the cut end of the esophagus is marked on the serosa

N —The posterior wall of the esophagus is anchored to the stomach 1 cm above the anastomosis with fine mattress sutures of silk (5 zero Deknatel preferred)

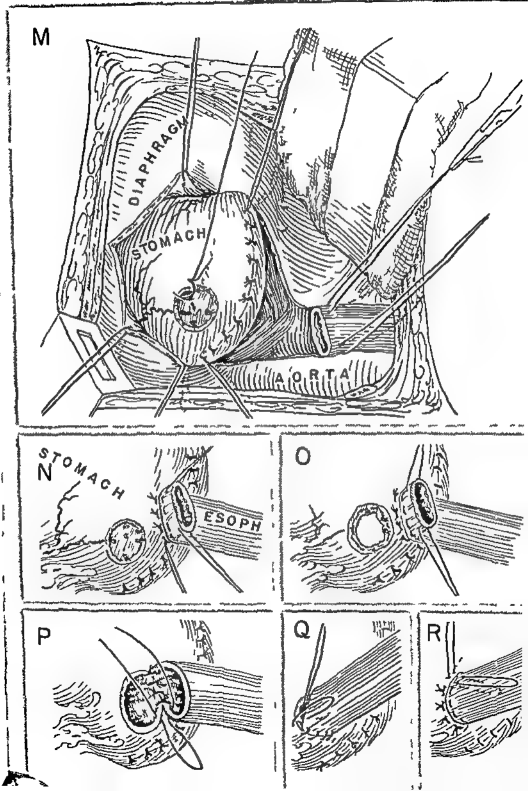
O —A second posterior muscular layer is inserted and tied placing the suture halfway between the first row and the gastric stoma. The circular excision through the gastric wall is then completed

P —The posterior inner row is of interrupted silk Lembert sutures with the knots made inside They catch only the mucosa of the stomach but for a secure bite usually must catch the entire thickness of the esophageal wall

Q —The anterior mucosal layer is similar with interrupted sutures and knots inside The Levin tube is drawn down through the anastomosis before this row is completed

R —Two outer anterior rows of mattress sutures are placed completing the anastomosis At the conclusion the anastomosis must lie without tension and the blood supply must be adequate at all suture lines Rough technic may result in hematomas and necrosis particularly in the narrow strip which lies between the anastomosis and the closed end of the stomach

[Proximal partial resection *continued on page 270*]


M
DIAPHRAGM
STOMACH
AORTA
N
STOMACH
ESOPH
O
P
Q
R

S —The anastomosis may be reinforced with omentum and brought up above the diaphragm All tension will be taken off the esophagus by anchoring the stomach to the diaphragm Sutures to close the anterior portion of the diaphragm are being inserted

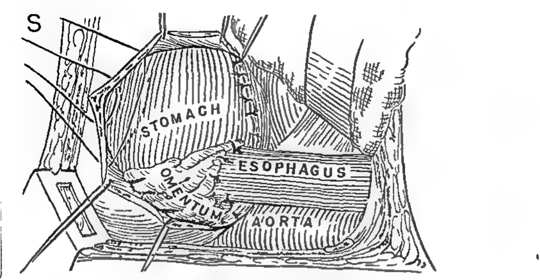
T —The stomach has been anchored to the diaphragm by a circular row of interrupted sutures *1–2–3* The remainder of the diaphragm has been closed by sutures *4–2* The lung is re expanded and the chest wall closed with drainage

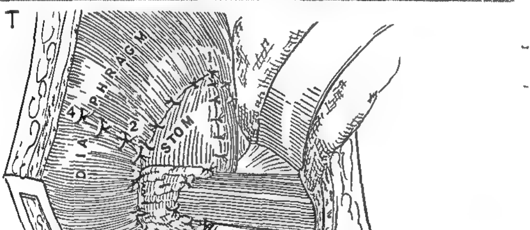
U —A diagram of the completed operation shows the position of the shortened stomach It must be emphasized that if this anastomotic technic is to be used the surgeon must be most gentle and *meticulous Since sutures cannot be placed over 3 mm apart* the anastomosis is time consuming An alternative technic that is somewhat less satisfactory is the anastomosis illustrated in Plate 61

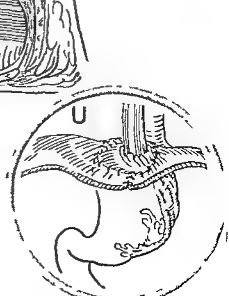
Postoperatively disturbances of gastric motility are common probably as a result of the bilateral vagotomy that is incidental to the operation The disturbance may be severe enough to simulate pyloric obstruction and may require a drainage operation A pyloroplasty is usually more satisfactory than a gastroenterostomy because of the shortened stomach

It will be readily appreciated that the exact operation described will not be required for all tumors of the cardia For example small neurofibromas may be exposed in the same manner through the thorax but can be excised locally without partial resection Further in some instances in which partial resection is done for benign lesions and the abdominal esophagus is perfectly normal it is not necessary to divide the diaphragm all the way through the hiatus The abdominal rather than the thoracic esophagus is then used for the anastomosis

REFERENCE **Churchill and Sweet**


S
STOMACH
ESOPHAGUS
OMENTUM
AORTA


T
DIAPHRAGM
STOM
1
2
3
4


U

The transabdominal route for total gastrectomy is preferred by most surgeons However there must be no hesitation in extending the incision into the left chest when necessary If preoperative studies indicate involvement of the esophagus and the lesion probably is resectable the transthoracic route is preferred If the esophagus probably is uninvolved or if the tumor probably will be inoperable we prefer an abdominal incision which can be extended by the technic shown in Plate 12

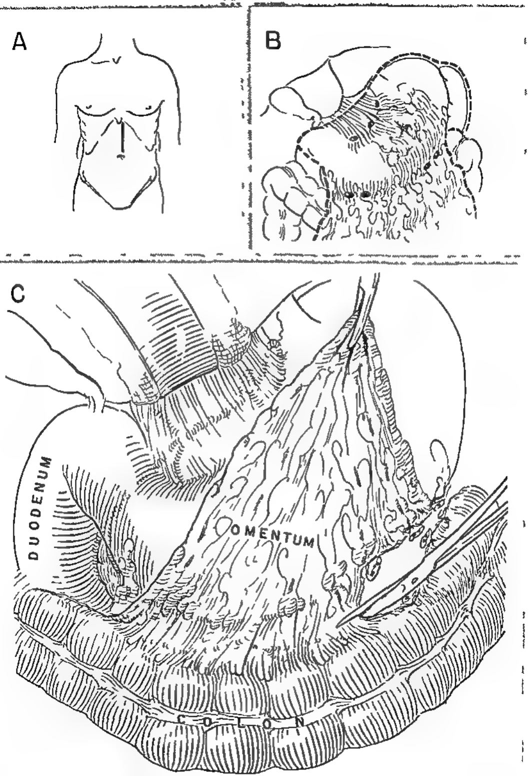
A—In patients with broad costal flares this is a particularly favorable approach A left paramedian incision is preferred

B—The extent of the resection is shown At least [illegible] cm of duodenum 1–2 cm esophagus both greater and lesser omenta and the spleen are removed en bloc with the stomach The right gastroepiploic right gastric left gastric and splenic arteries are tied as near to their origins as possible All six primary groups of gastric lymph nodes are removed

The technic of mobilization of the lower portion of the stomach will be repeated briefly to avoid frequent cross references

C—The omentum is removed from the colon beginning to the left of the midline and carrying the dissection up to the lower pole of the spleen and down to the duodenum In patients who require total gastrectomy it will often be found that adjacent viscera are involved particularly the transverse colon and the pancreas The transverse mesocolon is especially liable to be invaded at the point the midcolic vessels course parallel to the right gastroepiploic artery If there is direct invasion of the pancreas to the right of the superior mesenteric artery the tumor is inoperable If the pancreas is involved to the left of this artery the tumor can be removed together with the distal half of the pancreas

[Total transabdominal gastrectomy *continued on page 274*]


A
B
C
DUODENUM
OMENTUM
COLON

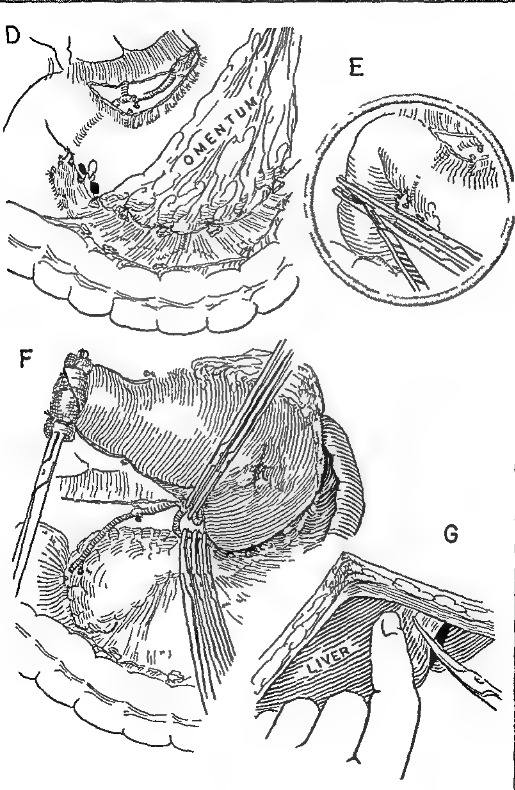
D—The omentum has been freed from the colon and is lifted upward The small adventitious vessels running from it to the colon have been ligated As the stomach is retracted the midcolic vessels are demonstrated Posterior adhesions of the stomach to the pancreas are cut The sites of division of the right gastric, right gastroepiploic and superior pancreaticoduodenal arteries are shown

E—The duodenum has been mobilized and Allen clamps applied at least 2 cm beyond the pylorus The duodenum is transected with a scalpel The subpyloric lymph glands are to be excised with the stomach

F—The duodenal stump has been turned in by a three layer suture the details of which are given in Plate 45 A small strip of gauze has been tied over the clamp on the proximal duodenum The stomach is now elevated and drawn to the left The left gastric artery is usually divided next ligating it by the three clamp technic (Plate 60 *F*) just above its origin from the celiac axis The splenic vessels are then exposed Artery and vein are divided and ligated separately along the upper margin of the pancreas well proximal to the hilum of the spleen

G—Exposure of the esophageal hiatus now requires mobilization of the left lobe of the liver The left hand draws the left lobe down under tension while the supporting ligaments are cut Thereafter the left lobe is folded down covered with a gauze pad and held out of the operative field by a Deaver retractor

[Total transabdominal gastrectomy *continued on page 276*]


D
OMENTUM
E
F
G
LIVER

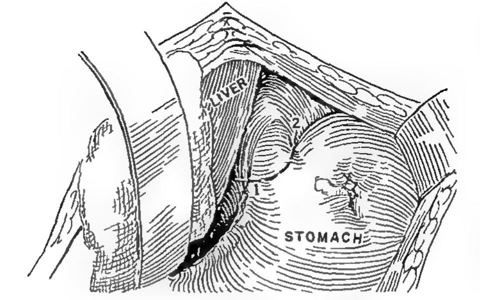
H —The stomach now has been mobilized all the way to the esophagus Unless the bulk of the specimen interferes with exposure or unless immediate pathological examination is necessary, the stomach is not removed because it furnishes an excellent retractor and aids in the exposure of the esophagus A gauze pad is tied about the stomach to diminish contamination The edges of the esophageal hiatus are palpated Following Lahey s suggestion a flap of peritoneum is to be preserved to protect the anastomosis Consequently the peritoneum is incised along the curved line *1–2* rather than at a higher level immediately in the hiatus

I —The flap of peritoneum has been elevated with a hemostat to demonstrate the lower esophagus By blunt dissection with the left index finger the esophagus is gradually freed from within the mediastinum and pulled below the diaphragm The taut vagus nerves are identified and cut allowing more esophagus to be withdrawn By these means 4–5 cm is delivered easily facilitating the anastomosis tremendously

J —A loop of jejunum is now brought up in front of the colon for the anastomosis There must not be any tension on it, very rarely one of the blood vessel arcades has to be cut or a Roux anastomosis done The top of the loop of jejunum is rotated anteriorly so that the first line of sutures runs from the esophagus 2 cm above the open end to the jejunum 2 cm posterior to the antimesenteric margin (*1–2*) Fine Halsted sutures of silk catch the full thickness of the esophagus but do not penetrate the mucosa The sutures are to be placed 2–3 mm apart Four to six will be required on the posterior row Silk is preferred to cotton for this particular anastomosis because frequently it is done through a relatively deep exposure and since silk sutures have less friction than cotton it is easier to set silk knots accurately at this depth

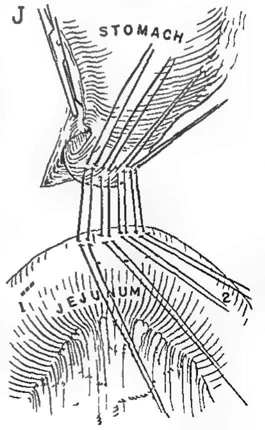
[Total transabdominal gastrectomy *continued on page 278*]

H



I

J



K—A second posterior row of sutures is then applied 1 cm posterior to the antimesenteric margin of the jejunum The jejunum is opened exactly on the antimesenteric margin The Levin tube is pulled back into the esophagus by the anesthetist. The stomach is then grasped with a right angle clamp at the cardia Suction is now maintained on the Levin tube as the esophagus is opened across the posterior wall

L—The inner row of sutures is now inserted A running lock stitch of 000 chromic catgut is used By locking each stitch the width of the anastomosis will not be reduced to a dangerous point

M—As the angle is reached the anterior wall of the esophagus is divided removing the stomach

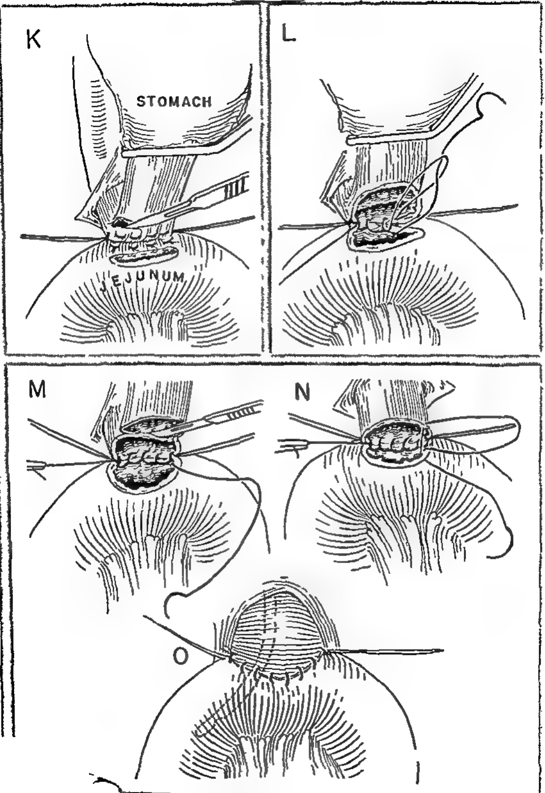
N—The inner suture is then continued about the angle and carried back to the right side of the anastomosis where it is tied

O—The anterior inner layer has been completed Just before closure the Levin tube has been brought down through the anastomosis and placed in one of the jejunal loops

If this mucosal suture is inserted with care avoiding too much tension or constriction the suture will be perfectly satisfactory It is also possible to avoid constriction by the use of interrupted sutures throughout the mucosal row When this is done the sutures are of very fine silk, and the knots are placed inside the lumen Sweet prefers a three layer anastomosis with 5-0 Deknatel The technic is similar to that shown in Plate 60 *N–R*

[Total transabdominal gastrectomy *continued on page 280*]

PLATE 61



P—The outer anterior layer of interrupted silk sutures of the Halsted type is placed with particular care being taken at the angles The sutures then are tied completing the anastomosis

Q—The flap of peritoneum at the hiatus that had been elevated previously (figure *H*) now is sewed to the anterior wall of the jejunum producing a strong support for the anastomosis

R—The jejunum now may be sutured to the diaphragm by two or three supporting stitches placed on either side of the anastomosis This will relieve kinking and obstruction

S—An enteroenterostomy is made between the afferent and efferent jejunal loops This is an important anastomosis since without it the duodenal secretions will regurgitate into the esophagus The anastomosis should be made about 5 cm long It is made with an outer layer of silk or cotton sutures and an inner of catgut The insertion of a jejunostomy tube for nutritional purposes is optional.

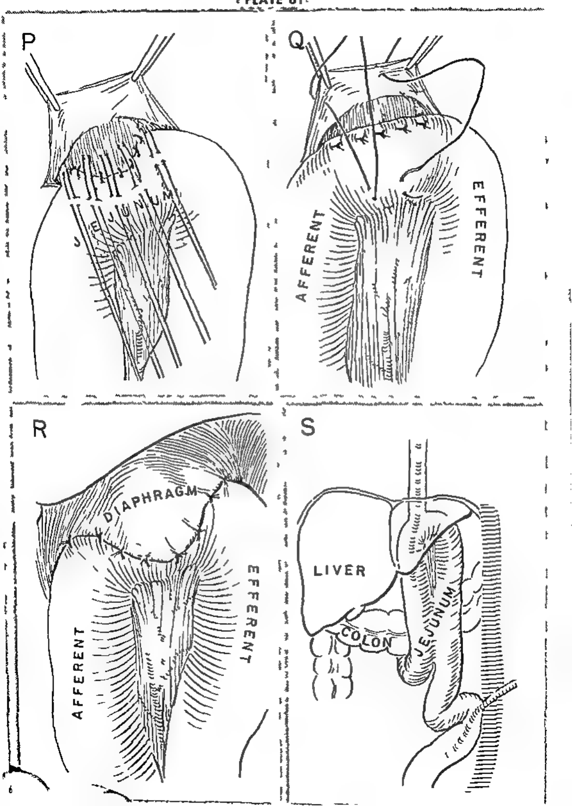
We have not used drainage except when the pancreas has been partially resected or traumatized If drainage is necessary the drain should be inserted through a stab wound and should extend down to the tail of the pancreas

Complications and after care—Most of the complications following total gastrectomy are dependent on the esophagojejunostomy A Levin tube inserted through the anastomosis for decompression of the jejunum should not be left in place over 48 hours because of the possibility of ischemic necrosis along the esophageal suture line Occasionally one to four months after operation constriction of the anastomosis by scar tissue will occur Consequently lower esophageal obstruction that is noted during this period must not be assumed to be due to recurrent cancer Dilatation of the stricture through the esophagoscope is indicated

REFERENCES Allen Lahey Scott and Longmire Wangensteen.

[Replacement technics *on page* 282]

PLATE 61


P
JEJUNUM
Q
AFFERENT
EFFERENT
R
DIAPHRAGM
AFFERENT
EFFERENT
S
LIVER
COLON
JEJUNUM

Replacement of the excised stomach by some visceral receptacle has been tested clinically and experimentally after total gastrectomy Numerous procedures have been tried including some very complicated operations that form a large pouch by the anastomosis of several jejunal loops The most common operations are shown here

T —The stomach has been excised Replacement is to be carried out by a transposition of the right colon according to the method of Hunnicutt and Lee The right colon must be freely movable or this operation will be impossible The ileum will be divided a few inches above the ileocecal valve and the colon just distal to the hepatic flexure

U —The ileum has been sutured to the esophagus and the colon to the duodenum An ileocolostomy will finally be made to reestablish intestinal continuity This is a difficult operation since there is likely to be interference with blood supply or tension on the anastomosis

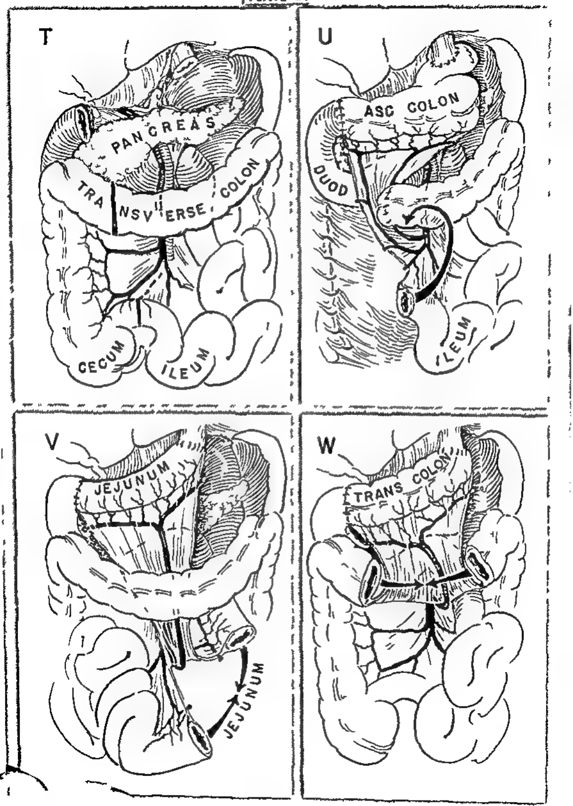
V —The stomach is replaced by a segment of jejunum according to Longmire s technic Technically this is the most satisfactory of the operations The jejunal pedicle must not be too narrow or the blood supply will be jeopardized

W —The stomach has been replaced by a segment of transverse colon and an end to end suture of the colon is about to be done This operation done by Smithwick and others has been technically satisfactory

Any surgeon who uses these operations must realize that they will increase the mortality Further experience will be necessary to prove their value At present gastric replacements are used rarely in our hospital because of the increased mortality and because the patient requires several weeks or months to obtain adequate function of most transplants particularly when the colon is used However replacement of the esophagus by colon or jejunum has many advantages and is employed frequently

REFERENCES Longmire and Beal Hunnicutt Lee

PLATE 61


T
PANCREAS
TRANSVERSE COLON
CECUM
ILEUM
U
ASC COLON
DUOD
ILEUM
V
JEJUNUM
JEJUNUM
W
TRANS COLON

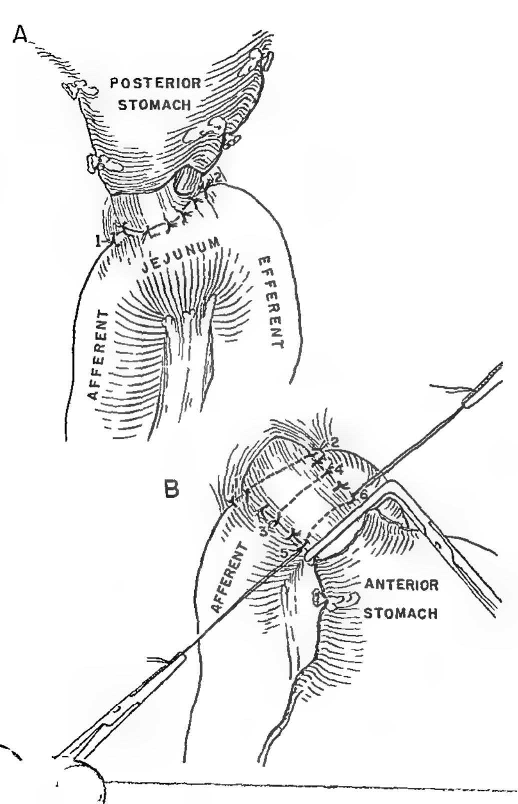
Recognizing the fact that the esophagojejunostomy is the most dangerous step in the operation of total gastrectomy, Graham devised a method by which the jejunum is wrapped about the anastomosis thereby reducing the possibility of leakage This is an excellent procedure and can be recommended highly

The gastrectomy and mobilization of the esophagus are carried out as shown in the preceding plate The stomach wrapped in gauze is left attached as a retractor

A—A long loop (12–18 in) of jejunum is brought up anterior to the transverse colon The afferent loop is then anchored to the right crus just lateral to the esophagus by one silk suture (*1*) and the efferent loop is anchored to the left crus (*2*) These sutures must be placed close to the esophagus or it will be impossible to rotate the jejunum properly for the next steps For the same reason not more than one suture is used on each side Several more silk sutures are then used to unite the posterior wall of the esophagus to the antimesenteric margin of the jejunum about 2 5 cm above the projected anastomosis

B—The efferent loop of jejunum is then rotated slightly so that the mesenteric margin is directly posterior The posterior wall of the esophagus is now laid directly on the anterior wall of the jejunum The upper row of posterior sutures (*1–2*) has already been placed It is possible to insert a second row (*3–4*) between the row *1–2* and the line at which the jejunum is to be opened Meanwhile several interrupted sutures along the lateral margins of the esophagus (*1–5* and *2–6*) complete the fixation to the jejunum The long ends of the distal stitches are retained as guy ligatures The Levin tube is pulled into the esophagus and a right angle clamp is then applied to the esophagus just distal to the line at which it is to be divided

[Graham s method *continued on page 286*]


A
POSTERIOR
STOMACH
1
2
JEJUNUM
AFFERENT
EFFERENT
B
2
4
6
3
5
AFFERENT
ANTERIOR
STOMACH

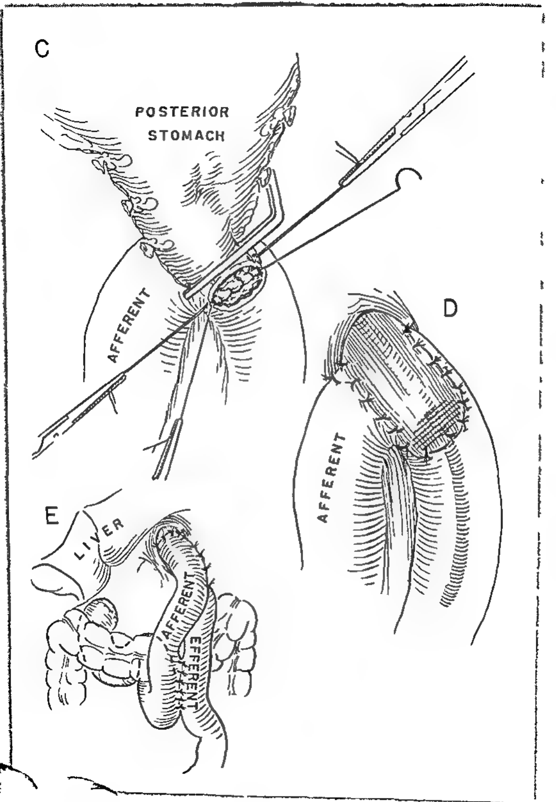
C —The stomach again is elevated and the jejunum is opened by a transverse incision This opening should center almost exactly on the antimesenteric margin Then with continuous suction on the Levin tube the posterior wall of the esophagus is opened If the esophagus is lax the stomach can be amputated at this stage otherwise it is retained until the posterior portion of the anastomosis is completed The esophagus and jejunum are anastomosed with a two layer suture The outer layer is of interrupted silk and the inner is a continuous lock stitch of 000 catgut made as illustrated in Plate 61 *L–O* Just before completion of the inner row the Levin tube is passed well down the efferent jejunal loop

D —The anastomosis has been completed and the guy ligatures cut The afferent jejunal loop is then rolled anteriorly and to the left so that it completely overlaps the anastomosis and the upper 5–7 cm of the efferent limb

E —The two limbs of jejunum are sutured along the left lateral margin The anastomosis is now entirely covered by the jejunum consequently if any necrosis of the esophageal wall occurs adjacent to the anastomosis there will be effectual protection against free perforation The proximal jejunum has necessarily been rotated in such a way that it is completely obstructed at the upper end and thus a wide enteroanastomosis must be made between the two jejunal loops

Although this procedure was described originally for total abdominal gastrectomy it also may be used when a total transthoracic gastrectomy is done However this method demands a slightly greater length of jejunum than other anastomoses and it may be difficult to secure enough jejunum if the esophagus has been amputated at a high level To aid in this mobilization one of the primary vascular arches of the jejunal loop may be cut (Plate 63 *K L*)

REFERENCE Graham

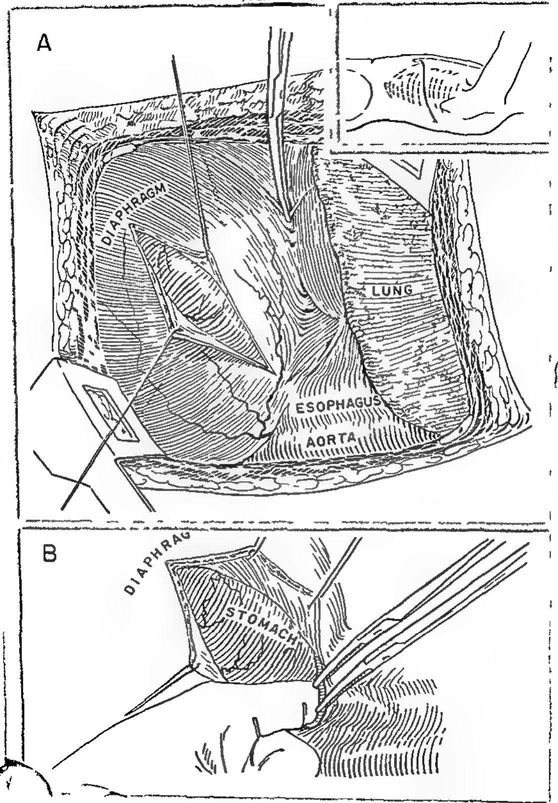

C
POSTERIOR
STOMACH
AFFERENT
D
AFFERENT
E
LIVER
AFFERENT
EFFERENT

This operation is not dissimilar from a total gastrectomy by the abdominal approach but is preferable whenever it is expected that more than 2 cm of esophagus will be resected

A —The left chest has been opened through the bed of the resected ninth rib (Plate 10) by a long incision extending from the costochondral junction to behind the angle of the rib The lung is retracted under a wet pad The phrenic nerve may be crushed just above the diaphragm The esophagus is palpated to note any extension of tumor into it or the adjacent lymph nodes The diaphragm then is elevated with forceps and incised in the region of the central tendon The incision is lengthened sufficiently to allow the introduction of the left hand The surgeon can then estimate the chance of removal of the stomach either in the hope of cure or as a palliative measure

B —The lesion is presumed to be removable If the esophagus is mobile and an adequate margin of normal stomach can be obtained above the tumor it is not necessary to divide the diaphragm all the way down to the esophagus If the hiatus is not opened the esophagojejunostomy will finally be made according to one of the technics demonstrated in Plates 62 and 63 Usually however the tumor extends so high that some of the thoracic esophagus must be included in the excision Under these circumstances as illustrated here the index finger is introduced through the hiatus and the remaining diaphragmatic fibers divided Stitch ligatures control all bleeding vessels in the diaphragm

[Total transthoracic gastrectomy *continued on page 290*]


A
DIAPHRAGM
LUNG
ESOPHAGUS
AORTA
B
DIAPHRAG
STOMACH

O

C—Bleeding vessels in the diaphragm have been controlled and traction sutures placed The anterior wall of the stomach left lobe of the liver and anterior surface of the spleen are now completely exposed The esophagus is mobilized by blunt dissection and a traction tape passed behind it

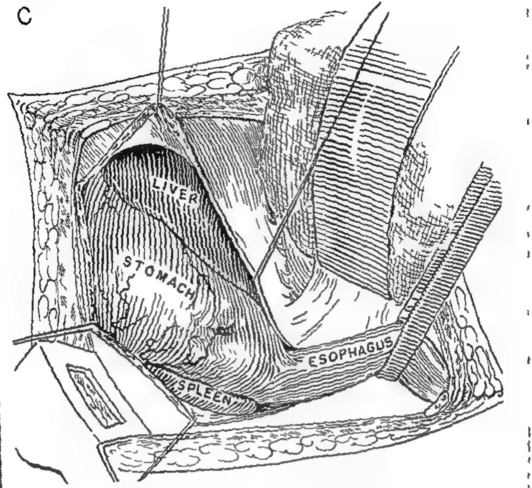
D—Mobilization of the stomach is to be achieved by the steps outlined in Plate 61 The spleen first is freed from its diaphragmatic attachments and elevated with the stomach The tail of the pancreas *is often involved and will require resection but it is not removed* routinely The omentum is separated from the colon as far as possible to be removed with the stomach Attachments of the omentum to old operative scars may make complete omentectomy inadvisable but the line of division of omentum must be at least below the gastroepiploic vessels so that the gastroepiploic nodes are completely removed

Thereafter the splenic vessels are divided and tied along the upper border of the pancreas The spleen must be removed when total gastrectomy is performed for cancer, for this is the only way all the splenic nodes can be obtained The left gastric vessels are then taken, the artery being divided just distal to its origin Before interruption of these major vessels the celiac axis is palpated carefully to make certain that the hepatic artery arises normally and will not be traumatized by the hemostats

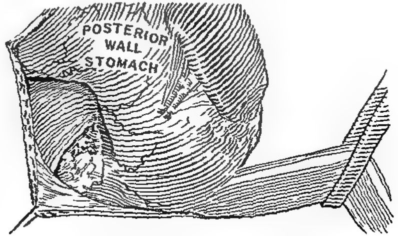
In this figure this mobilization of the upper end of the stomach has been completed The stomach and spleen are elevated The pancreas lies deep in the incision The splenic artery and vein have been interrupted just above the pancreas The colon is not visible since it has been freed from stomach and spleen and displaced downward

[Total transthoracic gastrectomy *continued on page 292*]

C



D



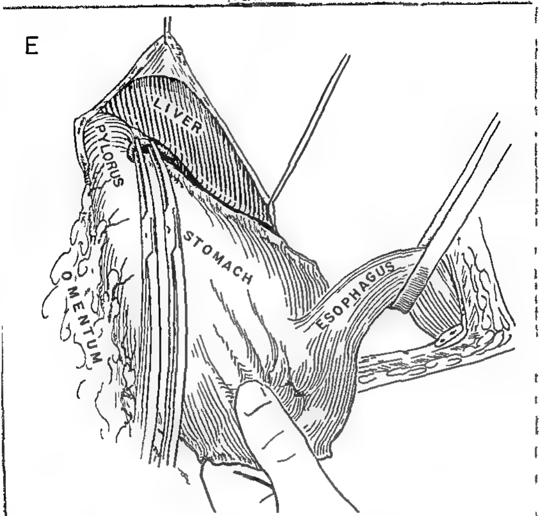
E—The stomach is drawn to the left and the lesser omentum divided close to the margin of the liver Any adhesions about the anterior duodenum are cut The right gastric vessels are divided as they approach the stomach The right gastroepiploic vessels are sectioned a short distance above their origin This particular part of the dissection is much more difficult through the thoracic than through the abdominal approach and if necessary the chest wall incision can be converted into a thoracoabdominal incision At any rate the subpyloric nodes must be included in the dissection and entire first portion of the duodenum mobilized In this figure clamps have been placed on the right gastric artery in preparation for the division

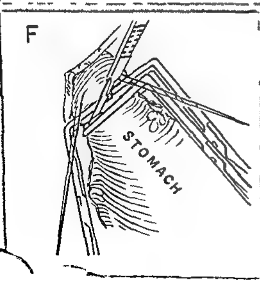
F—The duodenum must be divided at least 2 cm distal to the pylorus and even further if tumor extends throughout the stomach Since the dissection of the duodenum is deep in the incision it is often wise to use two Mixter right angle clamps to control the distal end The clamps are applied on either side of the duodenum while two traction stitches placed just distal to them aid in duodenal control A large right angle clamp then is placed distal to the pylorus and the duodenum is cut with a scalpel

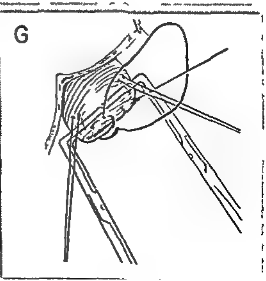
G—The duodenal stump is now turned in This can be done by the usual three layer technic A running continuous 00 catgut suture is begun at one end and carried down to the other Note that the upper end is not knotted

In the rare instance that an esophagoduodenostomy is planned the duodenum must be treated with even greater respect avoiding use of any clamps as it is divided Obviously in such a case the stump will be controlled by Allis forceps and guy ligatures until time for the anastomosis

[Total transthoracic gastrectomy *continued on page 294*]


E
LIVER
PYLORUS
OMENTUM
STOMACH
ESOPHAGUS


F
STOMACH


G

H —The clamps were removed as soon as the first row of sutures was completed The second row has been carried around the lower end and back to the upper as an inverting suture For details of the insertion of this suture see Plate 45 A third row of interrupted sutures now is being placed

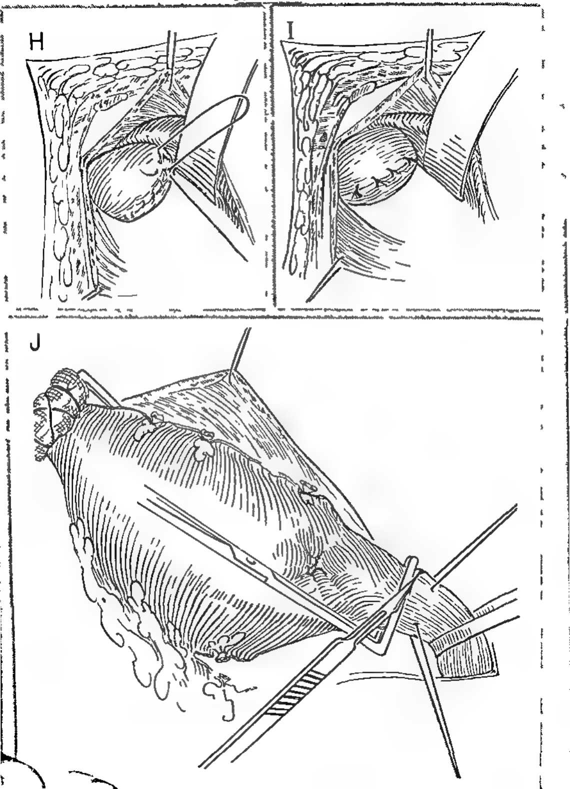
I —The sutures have been tied completing the closure of the stump Optionally reinforcement may be secured with omentum

J —The esophagus now will be divided The Levin tube is pulled up into the esophagus by the anesthetist A right angle clamp is then applied just above the cardia and guy ligatures are placed to control the esophagus Division is done with the scalpel while continuous suction is being applied on the Levin tube

The specimen is opened and examined by the pathologist The line of division of the esophagus should be 5 cm above visible tumor If necessary a further section of esophagus is excised

Serious consideration should now be given for the first time to the type of anastomosis that is to be done If too much attention is paid to this detail during the course of the resection, the surgeon is likely to compromise and not remove enough esophagus or duodenum Three methods of anastomosis are available In order of frequency of application they are (1) end to side esophagojejunostomy (2) Roux Y end to end esophagojejunostomy and (3) end to end esophagoduodenostomy The first two methods will be illustrated the technic of the third is similar to that of the second

[Esophagojejunostomy *on page* 296]


H
I
J

End to side Esophagojejunostomy

K.—A loop of jejunum is brought up anterior to the colon for the anastomosis This must be a long loop so that the anastomosis will be free of any tension If there is too much tension it is necessary either to divide one of the vessels in the jejunal mesentery or to do a Roux Y anastomosis In this instance a vessel is being divided The vessel chosen is the main one near the base of the anastomotic loop It is cut and ligated

L.—By the foregoing procedure approximately 3 cm has been added to the length of the jejunum Circulation to the jejunal loop now proceeds by way of the secondary arcades An end to side esophagojejunostomy then is carried out This may be done either by the usual three layer or by Graham s technic Here the three layer technic is illustrated The apex of the jejunal loop is rolled anteriorly and the dotted line represents the antimesenteric margin. The first row of sutures is placed about 1 5 cm posterior to the anti mesenteric margin and to the cut end of the esophagus

M.—The first posterior row has been completed The middle posterior row is being started

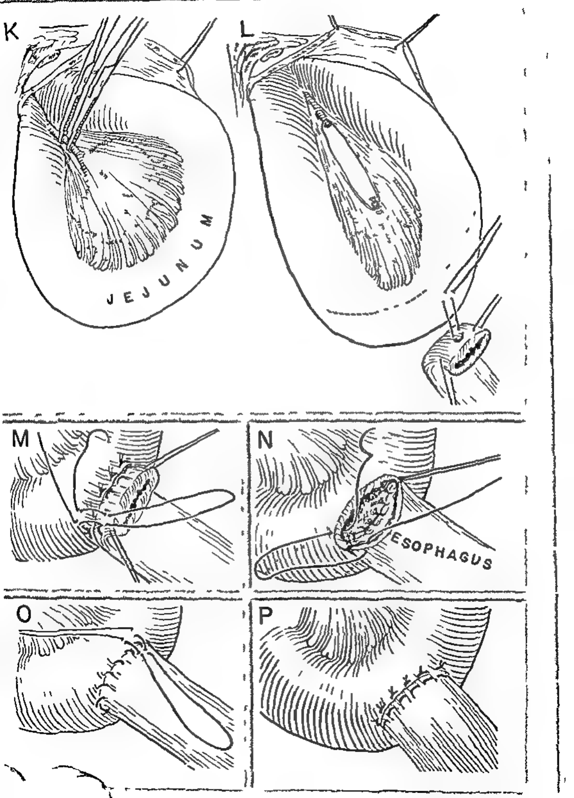
N.—The mucosal row is to be either a running lock stitch of 000 catgut or interrupted Lembert silk sutures tied with the knots inside The jejunum has been opened and the inner posterior row inserted It is often desirable to decompress the jejunum below the anasto mosis To accomplish this the Levin tube is now pushed down by the anesthetist and passed into one of the jejunal loops for a distance of 1 or 2 in It does not matter whether the tube passes into the afferent or efferent loop since an enteroanastomosis will be made

O.—The anterior inner row has been completed and the second anterior layer begun

P.—The third anterior layer has been completed

[Esophagojejunostomy *continued on page 298*]

PLATE 63



Q—An enteroanastomosis between the two limbs of jejunum is made and the diaphragm closed The jejunum is sutured to the diaphragm below the esophagojejunostomy In this figure the disposition of the viscera at the end of the operation is shown

R—The appearance of the thoracic cavity just before closure of the chest wall is presented

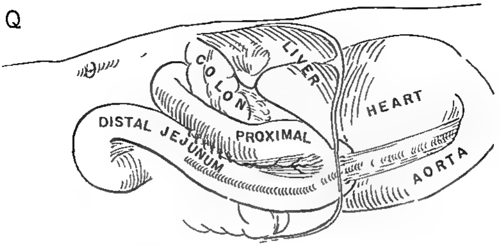
After care—The thoracic cavity is drained with a Foley catheter which is usually withdrawn in 48 hours The Levin tube is removed at the same time A close watch of the patient is necessary for the first week since in this period tension pneumothorax or anastomotic leaks are most likely to occur Not only are repeated physical checks necessary, but x rays of the chest should be taken two and five days after operation as an additional precaution Meanwhile, fluids by mouth are advanced cautiously beginning 48 hours after operation and progressing to a six meal bland diet in approximately two weeks

ESOPHAGODUODENOSTOMY—In perhaps 10 per cent of total gastrectomies it will be found technically possible to restore gastrointestinal continuity by an esophagoduodenostomy If this is to be done the surgeon must be absolutely certain that there is no tension on the anastomosis The duodenum is mobilized and the end to end anastomosis made as shown in Plate 63 *U–W*

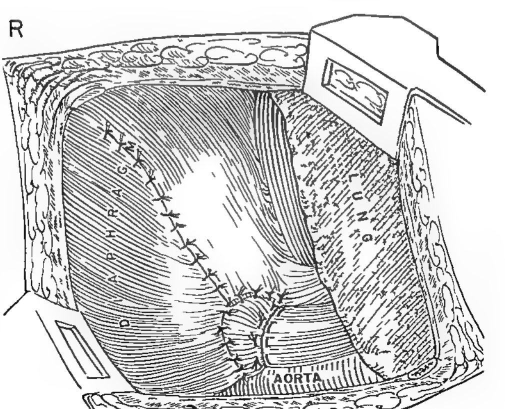
REFERENCE Sweet

[Roux Y esophagojejunostomy *on page 300*]

Q


LIVER
COLON
HEART
DISTAL JEJUNUM
PROXIMAL
AORTA

R


DIAPHRAGM
LUNG
AORTA

Roux Y Technic of Esophagojejunostomy

When the jejunal mesentery is short a satisfactory anastomosis to the esophagus often can be obtained by the Roux technic The anastomosis may be made within the chest or within the abdominal cavity

S —The loop of proximal jejunum is elevated as far as possible toward the esophagus It is then divided between clamps that are placed on the proximal side of the apex of the loop

T —By progressive division of the arcade of vessels in the mesentery the distal loop of jejunum is straightened and elongated The arcade closest to the jejunum must not be cut since it must provide blood supply to the anastomosis During this dissection ligation of individual vessels rather than use of mass ligatures is essential or the cut end of the distal jejunum will remain curled toward the mesentery and cannot be straightened

U —A careful end to end three layer suture now is made between esophagus and distal jejunum The first posterior layer of interrupted fine mattress sutures of silk is being placed

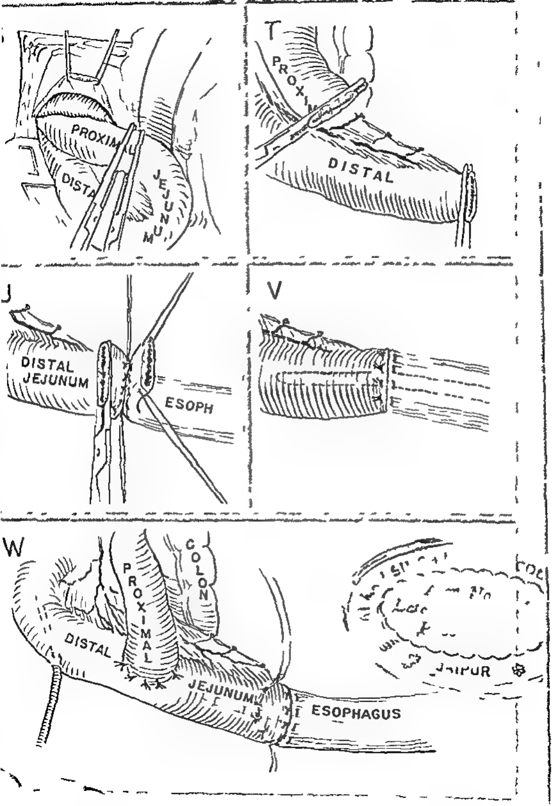
V —The anastomosis has been completed The second posterior layer is of interrupted Lembert sutures of silk and the inner row of a 000 catgut lock suture The anterior rows are similar The Levin tube is brought through the anastomosis before the inner layer is completed

W —The proximal jejunum is implanted into the distal jejunum by a two layer end to side suture The stoma is made exactly on the antimesenteric margin of the distal jejunum

If any omentum is available it is wise to wrap the anastomosis with it The diaphragm is then sutured to the jejunum below the anastomosis A jejunostomy for feeding may be made

REFERENCE Roux.

PLATE 63


PROXIMAL
DISTAL
JEJUNUM
T
PROXIMAL
DISTAL
DISTAL JEJUNUM
ESOPH
V
W
PROXIMAL
COLON
DISTAL
JEJUNUM
ESOPHAGUS

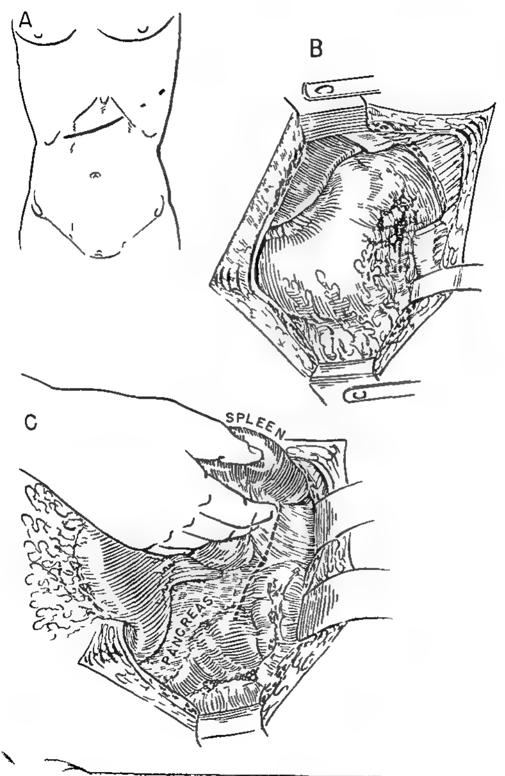
McNeer's term "extended total gastrectomy" is applied to an operation which combines total gastrectomy, splenectomy and partial pancreatectomy. It permits a much wider dissection of nodes than the usual total gastrectomy since the nodes in the splenic hilum and along the splenic vessels can be excised. While splenectomy and partial pancreatectomy can be combined with subtotal gastrectomy, in most instances this extensive operation is required for cancers of the proximal or midstomach so that a total gastrectomy is usually preferable.

A.—An abdominal incision is made primarily to determine whether or not the lesion is operable. The incision then can be extended in an appropriate manner.

B.—In most instances a thoracoabdominal incision will be necessary, with division of the diaphragm part way or entirely down to the esophageal hiatus.

C.—The omentum has been separated from the colon and is elevated with the stomach. The spleen is separated from the splenic flexure of the colon and swung forward. Several gauze pads may be packed in the bed of the spleen to keep viscera from being pulled upward by respiratory movements. As the spleen and pancreas are rolled forward, an avascular plane is encountered. The retroperitoneal area is entered by cutting just to the left of the aorta along the dotted line.

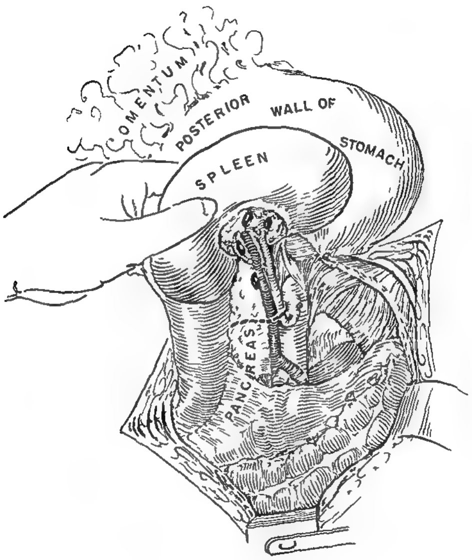
[Extended total gastrectomy *continued on page 304*.]


A
B
C
SPLEEN
PANCREAS

D—By dividing the peritoneum just lateral to the aorta the entire celiac axis can now be demonstrated The left kidney adrenal and crus of the diaphragm will be exposed to the left of the aorta The inferior mesenteric vein will be seen running behind the pancreas at the lower margin of the dissection The esophagus is mobilized by blunt dissection and pulled down with a traction tape The splenic and left gastric arteries are now divided about 1 cm from their origins and sutured by double ligatures The splenic vein and pancreas are divided at the same level Unless it has been necessary to do so before to secure exposure the right gastroepiploic and right gastric arteries are now ligated close to their origin and the duodenum divided 2 cm distal to the pylorus

[Extended total gastrectomy *continued on page 306*]

D



E.—At the conclusion of this phase of the dissection the duodenal stump has been sutured. The cut end of the pancreas has been closed with two layers of cotton sutures. Because leakage from the distal end of the pancreas is quite common, it is well to attempt to bring the stump whenever possible in the retroperitoneal tissue covering the end carefully with whatever fibrous tissue or peritoneum is available. The stomach is now used as a retractor and the esophagus is mobilized further. Vagus nerves are cut to permit greater mobility. If necessary, the diaphragm is divided down to the esophageal hiatus to allow adequate exposure.

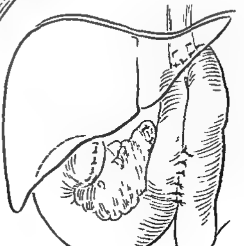
F.—Esophagojejunostomy has been completed by the technic outlined in Plate 63 and an enteroanastomosis made.

The dissection involved in this operation is long and tedious, particularly that about the celiac axis. Great care must be taken during this stage to maintain the integrity of the hepatic artery, since it is highly vulnerable in this area. If this artery is cut at the celiac axis the patient may still survive provided there is an adequate anastomosis through the superior mesenteric via the inferior pancreaticoduodenal, superior pancreaticoduodenal and gastroduodenal arteries. Under such circumstances a pulsation should be palpable on compression of the structures in the porta hepatis after introduction of a finger into the foramen of Winslow. If none is present, the surgeon should attempt an anastomosis. In one instance in our hospital restoration of pulsations and survival followed anastomosis over a short Polythene splint.

REFERENCE: McNeer *et al.*

E

F



Exclusion procedure.—It is recognized that the best palliative operation for carcinoma of the stomach is a resection. However, resection is sometimes impossible. Carcinoma of the distal stomach not infrequently involves the head of the pancreas or surrounds the great vessels in such a way that the lesion is irremovable, yet some normal stomach remains at the upper end. The best operation under these circumstances is an exclusion procedure.

A.—The stomach is divided a few centimeters above the tumor between Payr clamps. No attempt to free the curvatures has been made except to clear enough space for application of the clamps and for the subsequent suture lines.

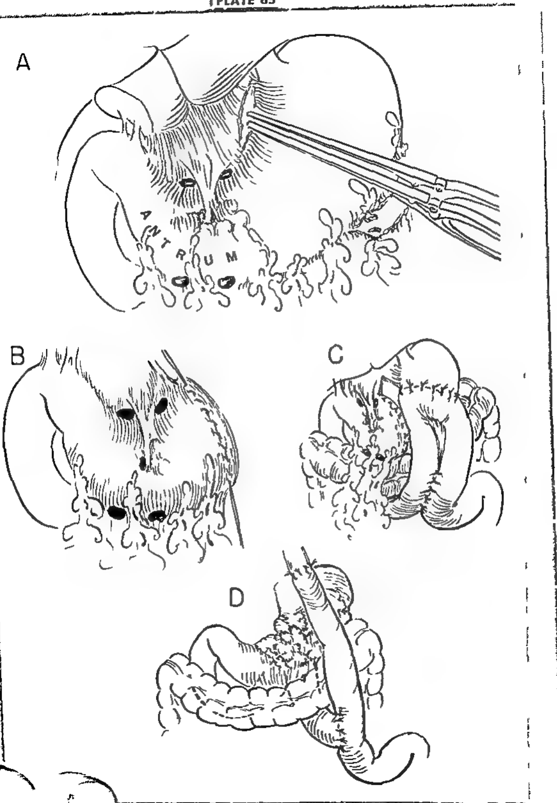
B.—The distal cut margin is now inverted. The lower Payr clamp is removed and replaced by a row of Allis forceps. The mucosa is then inverted by a running Connell suture, the Allis forceps being removed as the suture advances. The suture is tied at the upper and lower ends.

C.—Closure of the antrum has been completed by a second layer of nonabsorbable sutures. An anterior gastrojejunostomy and enteroenterostomy complete the operation.

Other palliative operations.—When the carcinoma involves the distal stomach and a resection or exclusion procedure cannot be done, an anterior gastroenterostomy may be the only available operation. If used, it may be expected that life expectancy will be very short, and an enteroenterostomy should be added to reduce the incidence of postoperative stomal obstruction.

When the carcinoma involves the cardia, a gastrostomy may be done, or the entire stomach may be excluded by an esophagojejunostomy.

D.—An esophagojejunostomy is done for extensive cancer. The esophagus is divided above the cardia and the distal end turned in. A loop of jejunum is brought up to the esophagus and anastomosed by the Roux Y technic (Plate 63, *S–W*).


A
ANTRUM
B
C
D

SECTION 17

Tumors of the Duodenum

THE COMMONEST BENIGN TUMOR of the duodenum is the single polyp and the commonest malignant tumor is cancer Besides these a number of other lesions have been described including lipomas neurofibromas leiomyomas enterogenous cysts pancreatic rests and various tumors of the lymphoma series Many are asymptomatic some produce obstruction and a few spindle cell tumors and polyps give rise to massive hemorrhage

POLYPS —It is not unusual for a polyp to arise from the stomach prolapse through the pylorus and thus appear to be a primary tumor of the duodenum Hence when a polyp is found in the first portion of the duodenum an attempt to reduce it back through the pylorus should be made After the base of the pedicle is located a gastrotomy or duodenotomy incision is made and the polyp removed

OTHER BENIGN TUMORS —Other benign tumors, if small may be removed by simple excision with reconstruction of the duodenum by two or three layers of sutures If they are large a sleeve resection of the duodenum may be carried out (Plate 17) The treatment of enterogenous cysts about the duodenum depends on size and location in brief treatment by excision or by cystenterostomy is preferable Papillomas of the ampulla of Vater if benign are excised and the posterior wall of the duodenum sutured to the common duct

CANCER —The optimal treatment for cancer of the duodenum is radical pancreaticoduodenectomy Since this operation also will be discussed in detail in another volume of this series (*The Biliary Tract Pancreas and Spleen*) only a single technic will be described here If the lesion is operable it may be removed by a one or two stage operation The one stage procedure is prefer

able but the two stage operation is necessary if there has been deep jaundice of over a months duration As a first stage we prefer the simplest possible operation a cholecystostomy under procaine anesthesia The second operation follows in two to three weeks

Unfortunately most of the carcinomas of the duodenum will not be operable because of local extension into the wall of the portal or superior mesenteric veins or because of hepatic metastasis "Palliative resections should not be attempted under these circumstances The surgeon may deal with pyloric obstruction by a gastroenterostomy Obstruction of the biliary tract may be relieved by a cholecystenterostomy if the cystic duct is not involved by tumor or by a T tube choledochostomy if the cystic duct is occluded

Although the number of cases of primary carcinoma of the duodenum in which resection can be carried out is very small and five year survivals very rare it seems logical to perform a radical excision whenever possible Anatomically this lesion resembles carcinoma of the ampulla of Vater more than that of the head of the pancreas in that it is farther from the portal vein and its tributaries

Postoperative complications following radical operations are numerous Pancreatitis hemorrhage local abscesses liver failure and stomal obstruction occur The most important factors in their prevention are careful anastomosis of the pancreas to the jejunum and adequate drainage of the operative site

Extrinsic tumors —Duodenal obstruction may be produced by a number of extrinsic tumors *Carcinoma of the pancreas* often produces complete duodenal obstruction in the late stages For this reason palliative cholecystenterostomy for this lesion should be accompanied by a gastroenterostomy *Retroperitoneal tumors* including lymphoma sometimes produce obstruction *Aneurysms* of the abdominal aorta may obstruct or perforate into the ascending portion of the duodenum The *annular pancreas* has been discussed in a previous section

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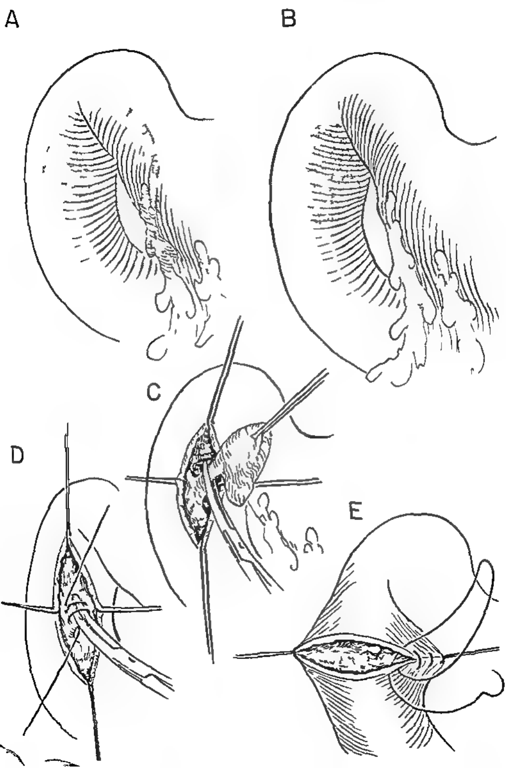

A
B
C
D
E

[312] *Duodenal Polyp Excision*

A—Polypoid lesions apparently primary in the duodenum may originate from the gastric mucosa and prolapse through the pylorus This is true not only of the true polyps but in certain instances of hypertrophied antral mucous membrane Hence when a polyp is palpated in the first portion of the duodenum an attempt is made to reduce it through the pylorus If this can be done a gastrotomy is done in the prepyloric area and the polyp or prolapsing mucous membrane excised

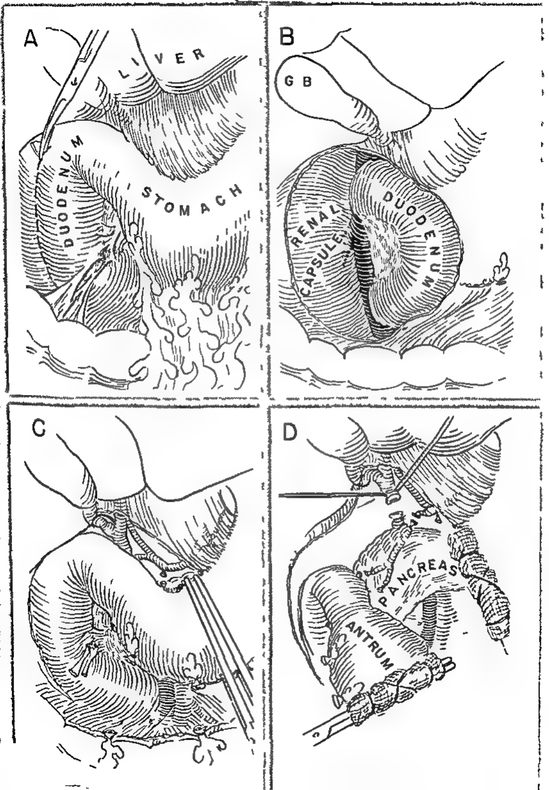
B—A polyp is palpated arising from the posterior wall of the duodenum

C—The duodenum is opened through a short vertical incision immediately over the polyp The polyp is elevated with an Allis forceps and a hemostat placed across the base The polyp is examined by the pathologist If there is invasion of the pedicle at the site of application of the clamp or if the polyp is sessile with no definite stalk a sleeve resection of the duodenum should be carried out, as shown in Plate 17

D—The polyp so far as can be told by gross appearance and frozen section is benign The base is secured by a 00 chromic catgut suture oversewing the hemostat and tying the ends as the clamp is withdrawn

E—The vertical incision is now closed horizontally with two layers of sutures

PLATE 67


A
LIVER
DUODENUM
STOMACH
B
G B
RENAL CAPSULE
DUODENUM
C
D
ANTRUM
PANCREAS

When definite carcinoma of the duodenum is encountered the best chance of cure is provided by a pancreaticoduodenal resection

A —The abdomen is explored to note the presence or absence of peritoneal or hepatic metastases If present only a gastroenterostomy and a cholecystenterostomy are indicated If absent the duodenum must be palpated carefully to determine whether or not the lesion is removable Involvement of the portal or superior mesenteric vein will make the cancer inoperable Metastasis to lymph nodes about the head of the pancreas renders the probability of cure very slight but does not contraindicate radical resection To determine operability the duodenum is mobilized by dividing the lateral peritoneal attachments and by mobilizing the hepatic flexure of the colon Whether or not there is extension on the posterior abdominal wall or into the vena cava can then be determined

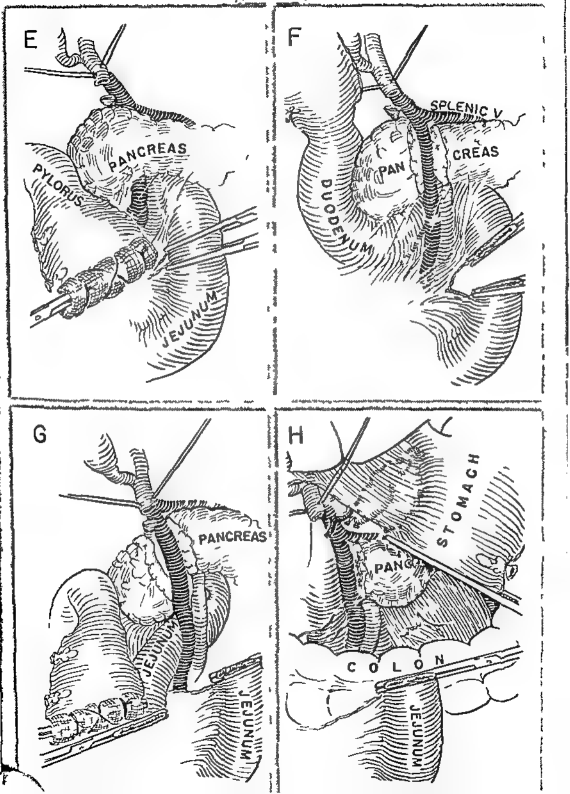
B —The duodenum is rotated anteriorly so that the head of the pancreas can be palpated The approximate course of the portal and superior mesenteric veins is determined and if tumor does not extend that far the radical operation is begun

C —The right gastric artery lesser omentum and hepatoduodenal ligament are divided freeing the lower 3 in of the lesser curvature of the stomach The greater curvature is mobilized for a similar distance reflecting transverse colon and mesocolon downward from stomach and duodenum The stomach is then divided between Payr clamps

D —The gastroduodenal artery is divided shortly below its origin great care being taken to be sure of the course of the hepatic artery to avoid injury to it The hepatic artery often dips downward sharply so that unless care is taken it may be ligated inadvertently It also may arise from the superior mesenteric artery and run in an abnormal position The common duct is divided just above the pancreas and controlled with guy ligatures

[Pancreaticoduodenal resection *continued on page 316*]

PLATE 67


E
PANCREAS
PYLORUS
JEJUNUM
F
SPLENIC V
PAN
CREAS
DUODENUM
G
PANCREAS
JEJUNUM
JEJUNUM
H
STOMACH
PANC
COLON
JEJUNUM

E—The jejunum is now divided between Allen clamps about [illegible] in. distal to the ligament of Treitz If the jejunal mesentery is short, more jejunum will have to be removed to allow a loop long enough for the subsequent anastomoses

F—The pancreas is divided carefully over the superior mesenteric vein Numerous small pancreatic veins will be encountered which will require the most delicate dissection or alarming hemorrhage can result When the anterior surface of the vein has been exposed, the head of the pancreas is freed from the right side of the vein This step is particularly difficult if there is an uncinate process of the pancreas enveloping the posterior aspect of the vein

G—The proximal jejunum is now freed from its short mesentery and the vessels ligated It can then be pushed back through the tunnel behind the superior mesenteric vessels at the ligament of Treitz passing it just anterior to the duodenum as it crosses behind the vessels The short vessels that enter the fourth portion of the duodenum are divided so that the entire block of tissue to be removed is transferred to the right of the superior mesenteric vein

H—The specimen is removed The anatomical situation prior to reconstruction is shown

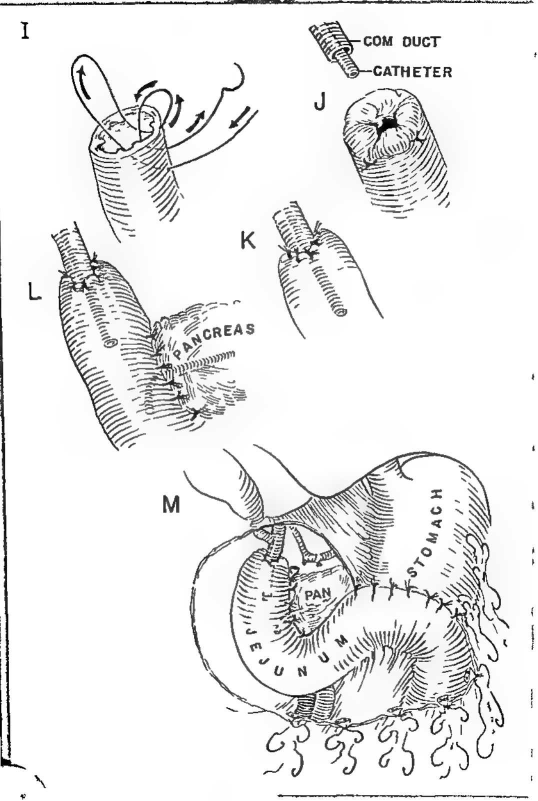
Several problems of blood supply may be encountered during the excision The most important are

1 Tumor is found to involve the superior mesenteric vein when the dissection is near completion Under these circumstances the surgeon must not ligate the vein if he cannot extricate himself otherwise some type of lateral closure of the rent in the vein wall or venous anastomosis must be carried out

2 The venous or arterial supply of the right colon may be traumatized by the dissection Great care must be taken in this location and the colon should be inspected carefully at conclusion of the excision of the tumor

A deliberate removal of the portal vein followed by plenectomy and anastomosis of the superior mesenteric vein to the vena cava has been carried out by a number of surgeons As McDermott has shown this procedure has carried a high mortality and even if technically successful has led to difficult postoperative metabolic problems

[Pancreaticoduodenal resection *continued on page 318*]


I
COM DUCT
CATHETER
J
K
L
PANCREAS
M
STOMACH
PAN
JEJUNUM

The following are essential features of the reconstruction (1) The common duct pancreas and stomach must be anastomosed to the jejunum (2) the gastrojejunal anastomosis must be the most distal anastomosis to avoid reflux into the biliary tree (3) the gall bladder must be removed if the cystic duct has been injured by the dissection When a long cystic duct parallels the common duct it is apt to be divided at the time the common duct is cut

Either an end to end choledochojejunostomy and an end to side pancreatojejunostomy or an end to end pancreatojejunostomy and an end to side choledochojejunostomy may be done The first method is shown here The distal jejunum may be brought through the duodenal canal behind the superior mesenteric vessels through an opening in the mesocolon or anterior to the colon If the jejunal mesentery is long enough the last method is the best since obstruction is least likely to develop

I —Allen s method of diminishing the width of the lumen of the cut end of jejunum is shown Four sutures are inserted about the cut end

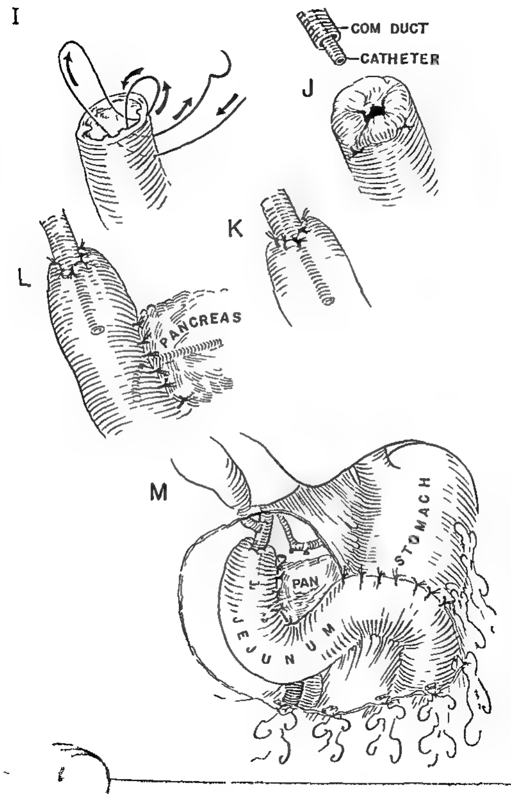
J —A short length of catheter of as large a size as possible is passed into the common duct and sutured in position

K —A single layer of interrupted silk or cotton sutures completes the choledochojejunostomy

L —A short section of a #10 catheter is inserted into the pancreatic duct and through a tiny opening into the jejunum and sutured in place The anterior and posterior surfaces of the pancreas are sutured to the wall of the jejunum

M —A gastrojejunostomy is done A catheter cholecystostomy is wise in many cases The abdomen is then closed with two cigaret wicks placed in Morison s pouch

[Pancreaticoduodenal resection *continued on page 320*]


I
COM DUCT
CATHETER
J
K
L
PANCREAS
M
STOMACH
PAN
JEJUNUM

The alternative method of reconstruction shown here consists of an end to end pancreaticojejunostomy end to side choledochojejunostomy and a gastrojejunostomy

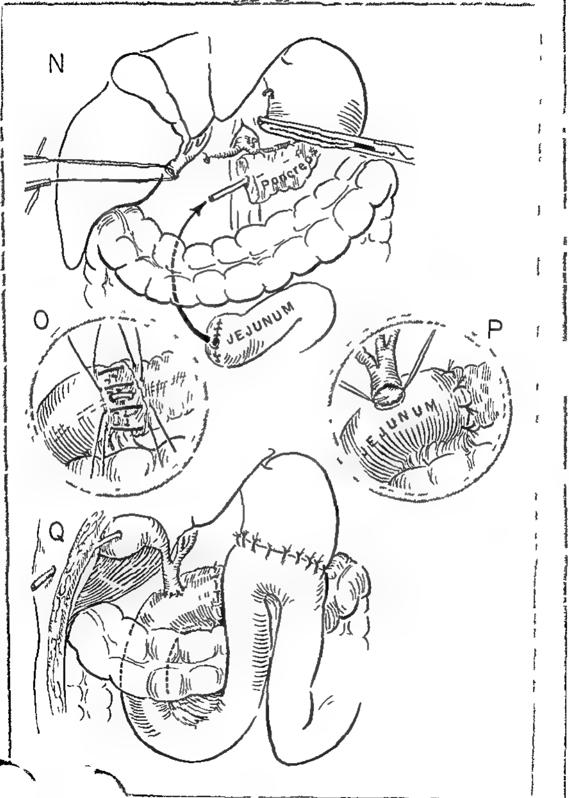
N—The resection has been completed The proximal end of the jejunum is now turned in with interrupted catgut sutures leaving a small hiatus in the center for insertion of the short section of a #10 catheter that has been anchored in the pancreatic duct This is accomplished after drawing the jejunum through an opening in the mesocolon as shown by the arrow

O—The capsule of the pancreas is now sutured to the serosa of the jejunum first posteriorly and then anteriorly by a row of interrupted silk or cotton sutures These may be either Lembert or mattress sutures depending upon the amount of fibrosis present in the pancreas and its capsule

P—Detail of the choledochojejunostomy is shown This is a two layer anastomosis The posterior wall of the common duct is sutured to the anterior wall of the jejunum by interrupted silk sutures The jejunum is then opened and a mucosal layer of interrupted sutures of catgut is placed Similarly two rows are placed anteriorly completing the anastomosis

Q—Completion of the reconstruction is illustrated An antecolic gastrojejunostomy of the Polya type has been made approximately 12 in distal to the choledochojejunostomy The opening in the mesocolon is closed about the proximal loop of jejunum

REFERENCES Brunschwig Whipple Parsons and Mullins


N
Pancreas
JEJUNUM
O
P
JEJUNUM
Q

SECTION 18

Complications of Gastric Resection

THERE ARE NUMEROUS COMPLICATIONS of gastric resection in the early postoperative period. The complications that will be discussed briefly include

1 Perforation of a suture line particularly of the duodenal stump or of an esophageal anastomosis
2 Hemorrhage from a suture line
3 Stomal obstruction
4 Sepsis either in the wound or intra abdominal
5 Pulmonary complications
6 Thromboembolism
7 Pancreatitis
8 Bile peritonitis
9 Wound dehiscence

1 PERFORATION OF SUTURE LINE — Disruption of the duodenal stump is the commonest. It occurs particularly after operation for duodenal ulcer when the duodenum was involved in scar or acute inflammation and the turn in was difficult. It appears one to eight days after operation and is diagnosed by the sudden onset of severe right upper quadrant pain. Unless drainage is carried out at once, the signs of peritonitis and shock follow rapidly though rarely a spontaneous fistula will form through the wound.

Anastomoses of the esophagus to either the jejunum or distal stomach are particularly likely to perforate unless meticulous care has been taken in the operation. Perforation is usually diagnosed by the signs of peritonitis or empyema depending on the location of the suture line. Wide drainage is indicated since a small perforation will usually heal with the aid of intensive chemotherapy.

Perforation of a gastric suture line is rare A gastroduodenal anastomosis is much more likely to dehisce than is a gastrojejunal

With any leaking suture line it is advisable to maintain the proximal portion of the gastrointestinal tract free from secretions In all cases a jejunostomy is performed to maintain nutrition In all but esophageal perforations a Levin tube is passed into the stomach and left on suction Rarely early reoperation and suture have succeeded

2 Hemorrhage from suture line —This usually occurs immediately after operation when an active mucosal vessel has not been ligated or five to seven days after operation when the catgut suture disintegrates The prothrombin time should be checked and vitamin K administered parenterally If not already in place a Levin tube is passed Transfusions are given Usually bleeding stops rapidly but if hemorrhage is massive and continues re exploration is necessary Unless another bleeding point is found and the bleeding has occurred *immediately after operation the anastomosis is taken down and* resutured meticulously If the bleeding is late it is usually preferable *to do a gastrotomy and to run a continuous catgut suture completely* around the anastomotic line from within the stomach

3 Stomal obstruction —*Obstruction of major significance oc*curs in nearly 5 per cent of patients following gastric resection Minor manifestations that can be managed by a reduction in oral intake or by repeated aspirations are more common Delayed emptying of the stomach is abetted by vagotomy because of the decreased gastric motility which results In some cases the complication is due to an actual mechanical defect Sometimes when reoperation is necessary an apparently normal stoma is found It is assumed therefore that edema of mucosa about the anastomosis is an important cause Obstruction is most common in elderly patients who have had pyloric obstruction before operation and who have a low serum protein It is wise to prepare these patients for possible malfunction of the stoma by a jejunostomy A second catheter passed in a retrograde fashion from jejunum to stomach will obviate a long continued use of the Levin tube

Stomal obstruction may persist for as long as six weeks and be followed by spontaneous recovery but it is almost impossible to maintain nutrition by the intravenous route during this period Reoperation to be successful must be done before the patient is *in extremis* If jejunostomy tubes are not in place it is advisable to

reoperate after total obstruction of one week in the older group, and after two weeks in younger patients

4 SEPSIS —Sepsis both in the wound and within the peritoneal cavity has been reduced greatly since the introduction of antibiotics When the factor of infection is likely to be important for example in extensive carcinoma of the stomach antibiotic therapy should be begun 24 hours preoperatively There is no evidence to support the local use of these substances either in the peritoneal or pleural cavities the intramuscular route is the one of choice At present we prefer the combination of penicillin 300 000 units, and streptomycin 0 25 Gm administered every six hours

The increasing frequency of pseudomembranous enterocolitis in postoperative patients and its usual association with heavy antibiotic therapy have made us unhappy about the routine postoperative administration of any antibiotics They are given now only as indicated

The drainage of a septic wound presents no special problem Peritonitis is now almost unknown except when it is due to an open suture line bile leakage or pancreatitis A bacterial peritonitis almost always can be controlled by antibiotics The favorite sites for secondary abscesses are in the subdiaphragmatic and subhepatic areas

5 PULMONARY COMPLICATIONS —The incidence of pulmonary complications exclusive of pulmonary emboli has also been greatly reduced by the antibiotics Of particular importance in this group is aspiration pneumonia Aspiration usually occurs coincidentally with administration of an anesthetic but may occur at any time if the patient is sufficiently depressed It is frequently fatal It is therefore imperative to empty the stomach as completely as possible before operation by a Levin tube or by a larger tube if necessary

6 THROMBOEMBOLISM —Elastic stockings are worn from the hour of operation Ambulation is begun on the day after operation Dicumarol is occasionally given as a prophylactic measure but should never be given after operation for ulcer unless the ulcer has been removed because of the danger of hemorrhage If thrombosis of the veins of the calf or pulmonary embolism occurs bilateral femoral vein interruption is carried out

7 PANCREATITIS —To avoid this serious and often fatal complication careful drainage should be instituted whenever there has been dissection deep into the substance of the pancreas The pancreas

must be treated as respectfully as possible during the operation

8 BILE PERITONITIS—Bile peritonitis may occur from a perforation of the biliary tract either by previous disease or by surgical damage Jaundice usually appears early and is followed by the signs of peritonitis and collapse Laparotomy is necessary If possible a cholecystostomy or choledochostomy is done but it may be that only right upper quadrant drainage can be instituted

9 WOUND DEHISCENCE—In nearly all instances careful attention to the details of incision and closure will prevent dehiscence If it occurs the wound is resutured using wire or cotton through and *through sutures and closing the entire wall in one layer* Layer by layer suture is usually impossible and unnecessary Sutures are placed every half inch along the length of the wound Pentothal anesthesia is most satisfactory

10 INTESTINAL OBSTRUCTION—Obstruction of the intestine may occur distal to the anastomosis Rare though particularly dangerous are hernias through traps left by an anastomosis Thus after antecolic gastrojejunostomy a loop of lower jejunum may herniate between transverse colon and the anastomosis If a long loop retrocolic anastomosis is made a loop of jejunum may herniate behind the afferent and efferent loops in front of the mesocolon A tight antecolic *anastomosis can also produce obstruction of the transverse* colon In addition to these special types of obstruction the ordinary types of postoperative intestinal obstruction may be encountered

Many other complications of less importance deserve mention *Jaundice* due to hemolysis of transfused blood may appear especially if numerous transfusions have been given rapidly for massive hemorrhage For *urinary obstruction* common in the early postoperative period an inlying catheter should be used it will simplify the calculation of the fluid output as well *Fecal impaction* is rare unless barium was administered and not removed by enema before operation Oil *retention enemas and digital extraction* may be required

Several mechanical aids have been advocated to reduce the incidence of postoperative complications particularly perforation of the duodenal stump

Decompression of the duodenum —Undue distention of the duodenum may be prevented in many ways A Levin tube may be threaded back into the proximal loop of jejunum, or a jejunostomy catheter may be inserted and the tip carried in a retrograde fashion proximal to the ligament of Treitz The duodenum may be decompressed directly by a catheter Since obstruction of the proximal loop at the gastrojejunostomy will increase duodenal tension any method that will prevent afferent loop obstruction will be of help

A —Alesen has devised an absorbable tube that is placed directly in the gastrojejunostomy It will automatically keep both afferent and efferent loops open until the tube dissolves at the end of seven days This should reduce the incidence of perforation of the stump as well as of stomal obstruction

Drainage of the peritoneal cavity —Drainage is not employed routinely but is advisable when there has been a difficult duodenal closure or extensive pancreatic dissection Rubber wicks and tubes may be used but sump drains are more efficacious

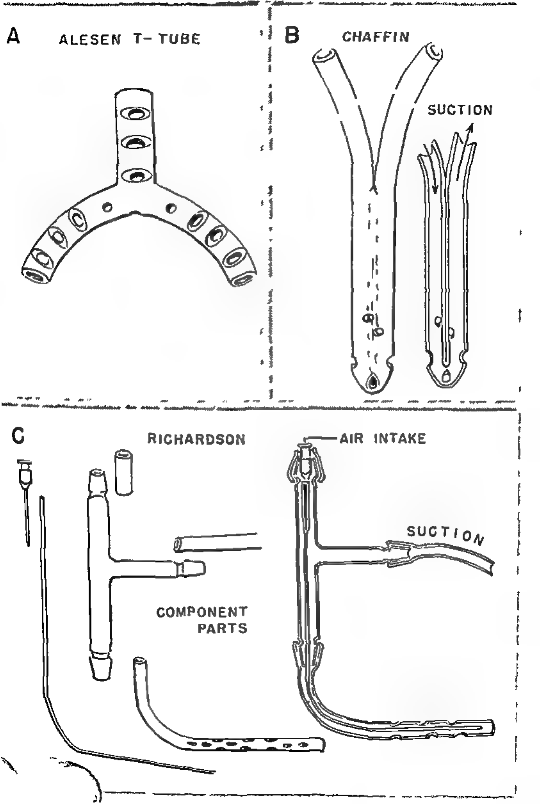
B —Chaffin s sump drain consists of a doubled rubber tube with multiple perforations at the tip The application of suction at one end draws a current of air through the tube effectively removing any fluid in contact with it

C —Richardson has made a sump drain of component parts that are easily available in any hospital—a glass T tube a rubber tube a #18 needle and a piece of fine polyethylene tubing The apparatus is assembled as shown in the diagram

References Alesen Chaffin Richardson

[Drainage method *on page 328*]

PLATE 68

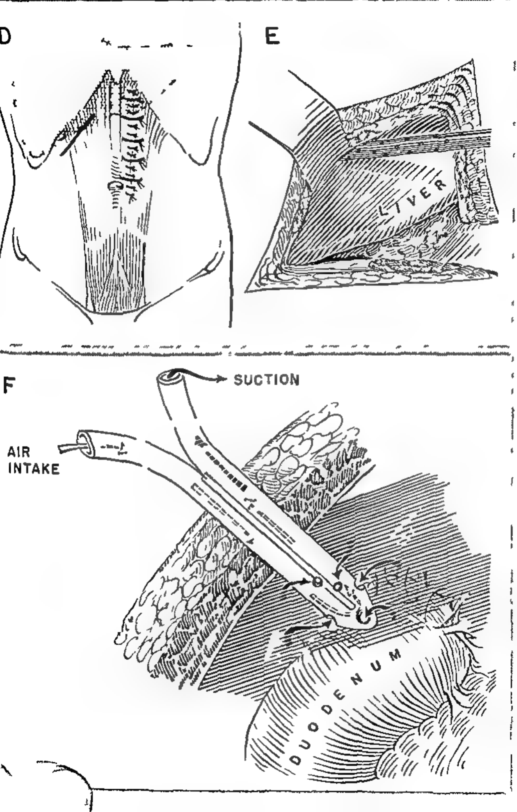

A
ALESEN T- TUBE
B
CHAFFIN
SUCTION
C
RICHARDSON
AIR INTAKE
SUCTION
COMPONENT
PARTS

D —Excellent anesthesia is afforded by local procaine infiltration along the line of incision supplemented by a small amount of sodium Pentothal An incision is made directly over the upper end of the duodenum dividing the lateral fibers of the rectus and the inner fibers of the oblique muscles directly in line with the skin incision

E —The peritoneal cavity has been opened Usually rather profuse thin bile stained drainage fluid appears at once If the fluid does not contain bile and is straw colored or bloody an acute pancreatitis should be suspected and confirmatory evidence sought in the form of fat necrosis With the sucker all available fluid particularly that over the liver and in the right gutter is removed

F —With gentle blunt dissection the finger is carried down the inferior margin of the liver separating it from colon and omentum until the region of the duodenal stump is reached Usually a good sized pocket of fluid will be found at this point It is impractical to expect to find the perforation or to put a catheter directly into the duodenum A Chaffin tube has been placed down to the duodenal stump and the wound closed loosely

Postoperatively suction can be applied to the rubber tube to help reduce the amount of drainage that comes in contact with the skin The wound must be protected with kaolin aluminum hydroxide gel or karaya gum powder The drains are gradually withdrawn in seven to 10 days If drainage persists a small catheter is inserted just below the skin level and strong suction applied until the tract closes


D
E
LIVER
F
SUCTION
AIR
INTAKE
DUODENUM

Reoperation for postoperative stomal obstruction should be carried out before the patient becomes entirely depleted As a rule of thumb it may be stated that a week of complete obstruction in elderly and two weeks in young patients may be tolerated if there is no relief at the end of this period operation should be done without further delay

A—Adequate exposure is essential, since fresh adhesions will make dissection difficult Consequently the entire incision must be reopened Occasionally, a true anatomical cause for the obstruction can be found for example a postcolic anastomosis may have been placed to the right of the midcolic artery and the jejunum become sharply kinked thereby Often however, the external appearance is surprisingly normal and it seems impossible to believe the function has not been perfect

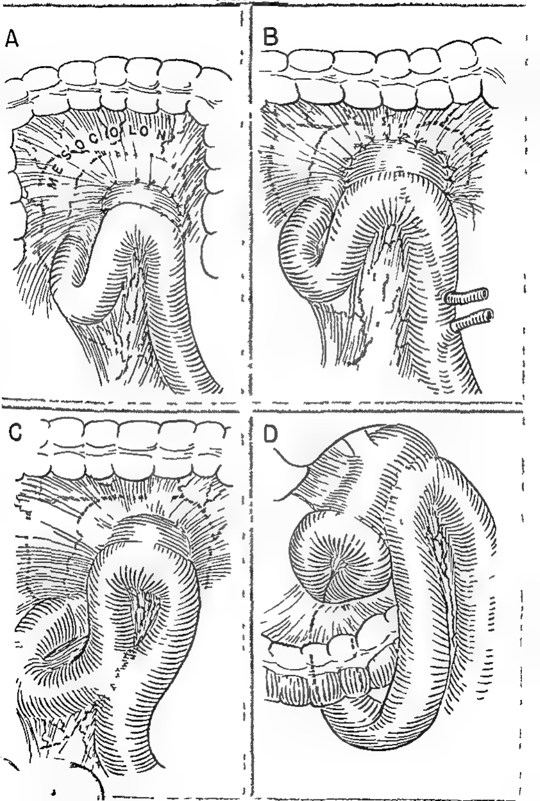
B—If the stoma appears normal a double jejunostomy is done according to the technic described in Plate 70 As the proximal catheter is passed it can be determined that there has been no agglutination of the gastric margins of the stoma this has been recorded as a bizarre cause of postoperative obstruction The catheters are retained until stomal function is resumed confirmatory proof being obtained by fluoroscopic barium studies

C—When the resection has been done for cancer an enteroanastomosis may be made between the afferent and efferent loops of jejunum This procedure gives excellent results Unfortunately it is contraindicated after resection for ulcer though it will relieve the obstruction an anastomotic ulcer probably will result at a later date

D—One well known type of obstruction after a retrocolic anastomosis is caused by the slipping of the mesocolon from the stomach and consequent constriction of the jejunal loops The resultant inflammatory reaction may be so great that no procedure can be used except an anterior gastroenterostomy A new gastroenterostomy will be successful only when an organic cause for the obstruction can be demonstrated

[Postoperative obstruction *continued on page 332*]

PLATE 69



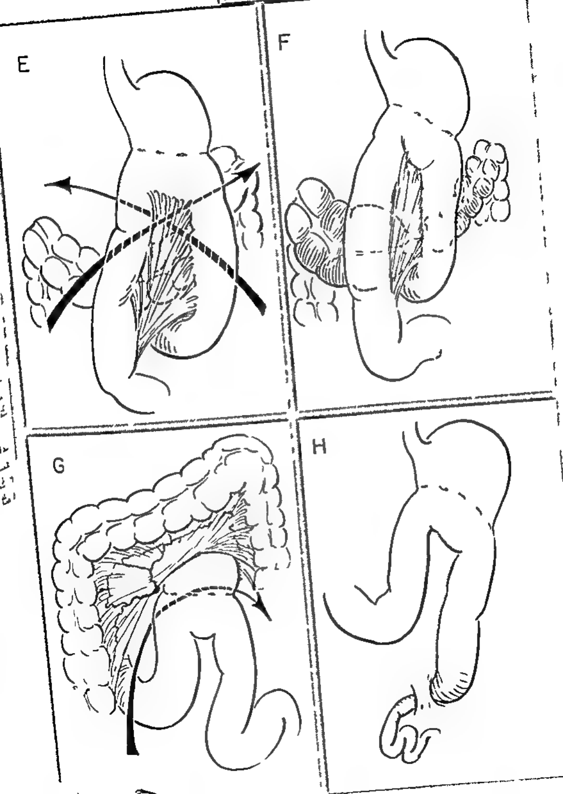
E—After an antecolic anastomosis, a trap is left between the colon posteriorly and the jejunal loop anteriorly. A loop of distal jejunum or ileum may prolapse through it in either direction as shown by the two arrows in this figure. Since such a prolapse is rare there seems to be little point in trying to prevent it by suturing jejunum to colon because this trap is difficult to eliminate. However if a hernia does occur some attempt to prevent recurrence should be made by closing the trap or even better convert the antecolic anastomosis to a retrocolic.

F—A more common cause of postoperative obstruction after antecolic anastomosis is compression of the transverse colon by a short afferent loop. This occurs a few days after the resection when edema is at a maximum. A cecostomy is the best method of relief. If this is done by a Gibson tube technic spontaneous closure of the stoma may be expected as the edema subsides.

G—After retrocolic anastomosis a lower loop of jejunum may prolapse in front of the base of the mesocolon and behind the anastomotic loop. In the diagram the course of the herniated loop is shown by the arrow. Such a hernia is very unlikely to occur unless the afferent loop is long.

H—Here postoperative obstruction was due to adhesions a short distance beyond the stoma. A swallow of barium usually is sufficient to make the diagnosis. The treatment is the same as for any such type of intestinal obstruction: usually lysis of adhesions is all that is necessary.

PLATE 69



The value of a Stamm jejunostomy as a definitive method of treatment of postoperative stomal obstruction has been appreciated for years A single catheter introduced for feeding will maintain nutrition until edema subsides and the stoma opens A second tube inserted in a retrograde manner into the stomach will eliminate the need of a Levin tube This method was developed by Allen and Donaldson and has been so effective and simple that they now advise it as a routine with all gastric resections A somewhat similar method has been used by Horsley who decompressed the stomach by a gastrostomy catheter instead of the jejunostomy catheter Most gastric resections are now made at so high a level that the stomach cannot be decompressed directly without hazard since the wall of the viscus should be apposed tightly to the peritoneum at the site at which the catheter emerges to avoid leakage Catheters must be tested carefully before insertion to be sure there are no perforations in the tube

A —The gastric resection has been completed Two #*16* catheters are to be inserted as shown in the diagram The upper opening in the jejunum is made 6–8 in distal to the anastomosis and the lower about 1 in below the first

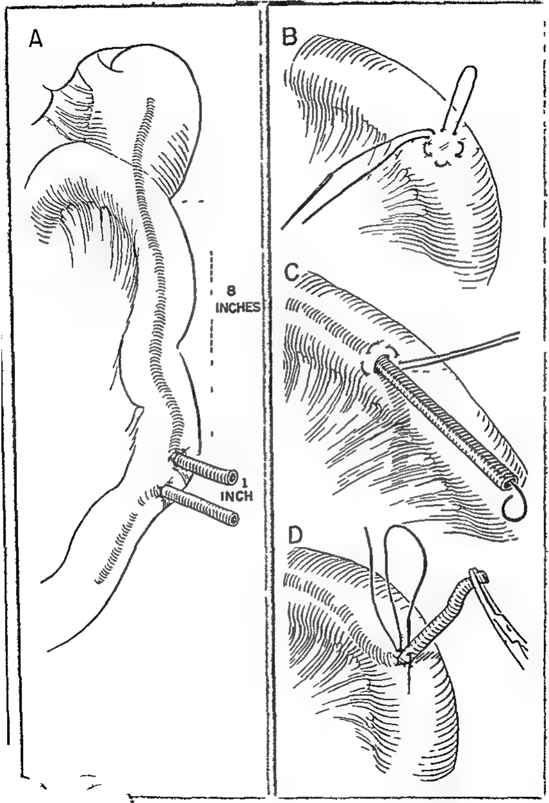
B —A pursestring is placed on the antimesenteric margin of the jejunum using a 00 plain catgut suture on a straight nontraumatic needle

C —The jejunum is opened with the scissors The catheter is threaded on a stilet and inserted by palpation into the stomach Care must be taken as it is put in to avoid injury to the anastomosis Under certain circumstances such as that in which closure of the duodenal stump has been less secure than desirable this proximal catheter may be threaded back past the anastomosis into the afferent jejunal loop

D —This suture is tied then anchored to the wall of the catheter and retied

[Double jejunostomy *continued on page 336*]

PLATE 70



E.—A second pursestring of chromic 00 catgut is placed and on tying, inverts the first pursestring A clamp is now applied to the open end of the catheter

F.—By the same method of two pursestrings a whistle tip catheter is inserted distally Introduction of this catheter is facilitated by injection of saline solution through an Asepto syringe as the tip is passed down the jejunum

G.—The catheters are now brought through a tag of omentum With the scalpel a small stab wound is made just lateral to the margin of the rectus sheath, a Kelley clamp inserted and the upper catheter drawn through The same procedure is repeated with the lower catheter

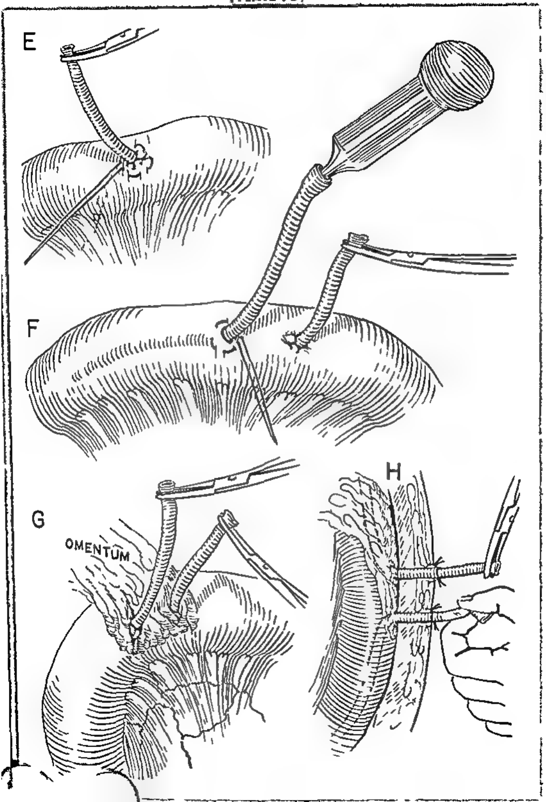
H.—By inspection and palpation, the catheters are brought snugly against the abdominal wall There must be no kink in the jejunum. Slight tension being maintained they are now sewed in place

Postoperatively the upper catheter is opened at once and drained by gravity The Levin tube is removed as soon as drainage through the upper catheter is activated usually a few hours after operation After three days in the uncomplicated case intermittent clamping of the tube may be carried out The lower tube is not used unless obstruction develops Both are removed 11 days after operation

These tubes do not prevent obstruction however if stomal obstruction develops it is no problem The tubes may merely be joined together by a piece of glass tubing for several days until the edema subsides or the gastric drainage may be collected from the upper tube strained added to the proper amount of homogenized milk or other food to furnish an adequate intake and reinserted through the lower tube

The stomach also may be decompressed by Farris technic using a Foley catheter (see Plate 20 *E*)

REFERENCE Allen and Donaldson


E
F
G
OMENTUM
H

If a subdiaphragmatic abscess is suspected every attempt should be made to localize it accurately by physical and x ray examination Fixation of either the right or left side of the diaphragm with fluid above and a gas bubble beneath it will make the diagnosis clear On the left side the stomach may be outlined by barium and any displacement presumed to be due to an abscess An area of localized tenderness over the lower ribs may point to the site of the abscess An exploratory incision with negative results is preferable to an undrained abscess

On the left side all abscesses may be approached through a sub costal incision but on the right either an anterior or posterior approach is required because of the barrier furnished by the suspensory ligaments of the liver For posterior abscesses Ochsner s approach is used

A —Local procaine infiltration supplemented by Pentothal anesthesia is best The skin incision is made directly over the twelfth rib

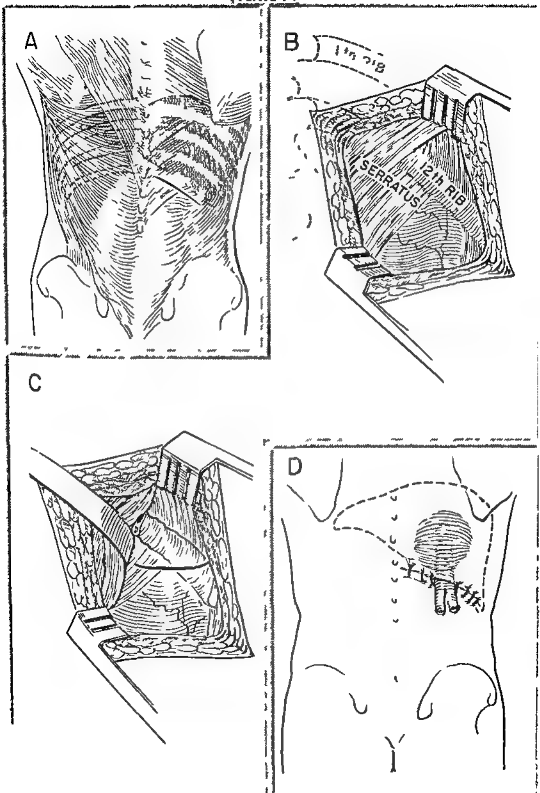
B —The twelfth rib is resected subperiosteally care being taken to avoid the pleura

C —A transverse incision is now made at the level of the first lumbar transverse process across the midportion of the bed of the twelfth rib This incision must not be too high or the pleural cavity will be entered When the incision is carried through the serratus and lumbodorsal fascia the finger can be introduced and brought all the way up to the suspensory ligament near the dome of the diaphragm The subhepatic space can also be explored through the same incision if necessary by entering the peritoneal cavity just below the liver

D —When the abscess is found drains are inserted and the wound closed loosely Here drainage is secured by a Chaffin sump Plate 72 *D* shows the planes of cleavage encountered during drainage

REFERENCE Ochsner and Graves

PLATE 71



A —A subcostal incision is made transecting the underlying muscle fibers It is carried down to the peritoneum but not through it.

B —The finger is now introduced between the anterior surface of the right lobe of the liver and the diaphragm It is then carried upward until the level of the abscess is reached here the peritoneum is opened and the abscess drained If there is any difficulty in locating the abscess the use of a long aspirating needle is often helpful If no pus is encountered in the subdiaphragmatic area it is often wise to open the peritoneum and explore the subhepatic space

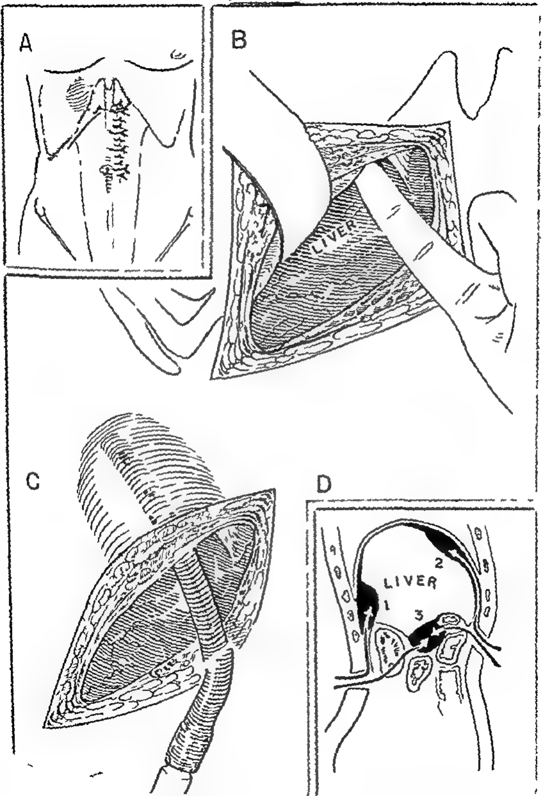
C —A Richardson sump drain has been inserted in the abscess cavity The wound will be closed loosely about it

D —The planes of cleavage that are encountered during drainage by the two approaches are shown The posterosuperior space is indicated by *1* the anterosuperior by *2* and the inferior by *3*

After drainage of a residual abscess antibiotics are continued in full amount The wicks and tubes are withdrawn gradually remembering that the deeper and older the abscess the longer the tubes should remain in place Usually they are entirely removed by the tenth day Saline irrigation of the cavity may be carried out after the fifth day

TRANSPLEURAL DRAINAGE — This procedure has now been abandoned by most surgeons It does however provide direct drainage of high posterior abscesses When used a 4 in length of rib overlying the abscess cavity is mobilized and a strip of gauze packed tightly beneath it The incision is then closed The underlying diaphragm should be adherent in three or four days At this time the incision is reopened the rib resected the diaphragm opened and the abscess drained It must be certain that the pleural space has been obliterated by the pack before the diaphragm is opened

REFERENCES Faxon Ochsner and Graves


A
B
LIVER
C
D
LIVER
1
2
3

SECTION 19

Late Complications of Gastric Operations

THE IMPORTANT LATE COMPLICATIONS of gastroenterostomy are anastomotic (or gastrojejunal) ulcer gastrojejunocolic fistula, reactivation of the duodenal ulcer and obstruction of the gastroenterostomy stoma If the gastroenterostomy has been placed too high on the stomach an active gastritis of the distal stomach with multiple superficial ulcers may appear Retrograde intussusception of the jejunum occurs rarely through the stoma into the stomach

After resection anastomotic ulcer and the "dumping syndrome" symptoms referable to the small stomach or severe loss of weight occur in a few patients Recurrent hemorrhage after resection is not uncommon and is usually due to a gastritis which may be aggravated by the ingestion of aspirin or other gastric irritants Space permits only brief consideration of these complications limited primarily to a discussion of their relief by operative procedures

1 ANASTOMOTIC ULCER —When gastrojejunal ulcers develop they originate in a third of patients within a year after the original operation in another third within two years and in the rest over varying intervals It is of interest that gastroenterostomy for hypertrophic pyloric stenosis in infancy has been followed 30 years later by anastomotic ulcer The incidence of ulcer after gastroenterostomy will vary depending on the selection of patients but probably is about 30 per cent After gastrectomy for duodenal ulcer the incidence varies from 1 to 10 per cent with a probable average of 5 per cent After gastric resection for gastric ulcer, anastomotic ulcer occurs in about 1 per cent

The recommended operative procedure for anastomotic ulcer following gastroenterostomy is a 75 per cent gastric resection When a gastric resection already has been done it first must be determined that the resection was adequate Usually either too conservative a resection has been carried out or the antrum has not been removed A higher resection plus vagotomy is usually the best procedure

Walters on the basis of an extensive series of operations believes that vagotomy is the safest operation when the ulcer occurs after a resection Seventy per cent of patients with anastomotic ulcer were free from symptoms one to eight years after vagotomy Vagotomy plus a higher gastric resection gave better results but at the expense of an increased operative mortality

The old operation of de gastroenterostomy for an anastomotic ulcer is regularly followed by reactivation of the original duodenal ulcer and should not be done

2 GASTROJEJUNOCOLIC FISTULA —This much more serious complication has usually been associated with a high mortality because of the accompanying inanition and sepsis at time of operation Consequently the preoperative preparation of the patient by administration of blood electrolytes and chemotherapy is exceedingly important Several operative measures may be considered in treatment They are

a) Resection of the fistula with reconstruction of the continuity of the jejunum and colon This procedure must be accompanied or followed by some definitive method of treatment of the underlying ulcer preferably a gastric resection or less frequently by vagotomy (Faxon)

b) Preliminary ascending colostomy followed by resection of the fistula and preferably gastric resection at the second stage This operation was originated by Pfeiffer

c) Preliminary ileosigmoidostomy followed by resection of the fistula, gastric resection and right colectomy (Laheys method)

3 MALFUNCTION OF THE ANASTOMOSIS —The patient may recover satisfactorily from the immediate operative procedure but be partially incapacitated by continuing episodes of vomiting and loss of weight. Some of these are due to malfunction of the anastomosis

One of the most interesting in this group is the "afferent loop syndrome" It is found particularly in patients who have had a long

loop antecolic anastomosis with partial obstruction of this loop at the gastrojejunostomy stoma and it is manifested by occasional episodes of vomiting of copious amounts of bile food is characteristically absent from the vomitus The patient may complain of tenderness along the course of the dilated afferent loop and barium studies may demonstrate stasis in the same dilated loop Relief may be secured by a complete revision of the anastomosis with formation of a new short loop a Billroth II or a Billroth I procedure

In other instances of malfunction reoperation has demonstrated angulation of a postcolic anastomosis about the midcolic artery or obstruction of an antecolic loop by adhesions

If the stoma has been placed too high on the stomach in gastroenterostomy either alone or combined with vagotomy the stomach empties poorly Gastritis with vomiting or bleeding follows Though several procedures may be undertaken to correct this abnormality the most satisfactory is gastric resection following the technic described in this section for anastomotic ulcer (Plate 74)

The stomach occasionally has been anastomosed to the wrong viscus For example what was believed to have been a gastrojejunostomy actually may have been a gastrocolostomy After gastric resection a gastroileostomy may be made by error rather than a gastrojejunostomy Diagnosis is usually easy because of the rapid development of diarrhea or a deficiency syndrome and is proved by gastrointestinal x ray studies Such an abnormal anastomosis must be taken down and a new one made

The size of the stoma has been blamed for many postgastrectomy symptoms Though a stoma about 4 cm long now is made by most surgeons there is little evidence to prove that longer anastomoses are followed by a higher incidence of the dumping syndrome Too small an anastomosis may lead to delayed gastric emptying When stenosis appears late after an operative procedure it usually indicates an anastomotic ulcer Secondary involvement of a stoma by gastric cancer must also be considered Cancer originating at the site of a gastrojejunostomy is rare but has occurred in our hospital It is clear that late stomal obstruction requires relief by operation

4 Dumping syndrome —If a very liberal definition of the dumping syndrome is made it is a common finding after operation On the other hand most patients control symptoms by elimination of one or

two items from their diet (e g milk ice cream or chocolate) Only a few actually are troubled by the syndrome Nearly all can be treated satisfactorily by attention to psychic factors and a solid diet high in calories The syndrome can be produced by adhesions of jejunum or ileum distal to the anastomosis and is relieved by lysis of these adhesions In a few instances the syndrome is so severe that operative relief is sought, though we have not encountered one such patient in the past 10 years in our hospital Some surgeons have reported cure of such patients by conversion of a Billroth II to a Billroth I anastomosis in which the stoma is intentionally made only 2 5 cm in diameter

5 ANEMIA —Anemia requires careful medical attention Vitamin B_{12} therapy may be necessary even after subtotal gastrectomy and is always necessary after total gastrectomy Correction of anemia has relieved dumping symptoms in many patients

6 GASTRITIS —This complication ascribed to regurgitation of bile is not uncommon after resection for ulcer according to Schindler Benedict however on the basis of gastroscopic biopsies believes it is rare

7 RECURRENT HEMORRHAGE —Recurrent hemorrhage after resection may be due either to gastritis or to an anastomotic ulcer Unless a defect can be discovered by x ray or gastroscopic examination medical therapy is indicated If there is recurrence an anastomotic ulcer is usually present

8 SEVERE WEIGHT LOSS —This is common after total gastrectomy Since it is much easier to prevent than to relieve high resections should be avoided whenever possible in patients who have always been thin or malnourished Women are more prone to this complication So far as therapy is concerned a high caloric intake is essential. The re establishment of a Billroth I anastomosis with the interposition of a jejunal loop between the esophagus or gastric remnant and the duodenum has been used successfully by some surgeons

9 Other causes of obstruction such as hernias about the anastomosis and intussusception through a gastroenterostomy stoma have previously been discussed

REFERENCES Faxon and Schoch Lahey and Swinton Pfeiffer Walters *et al*

Resection of Retained Antrum

When an anastomotic ulcer is diagnosed, medical therapy is usually found to be unsatisfactory and surgery is indicated Unless the surgeon is absolutely certain that the resection has been adequate, a laparotomy should be done

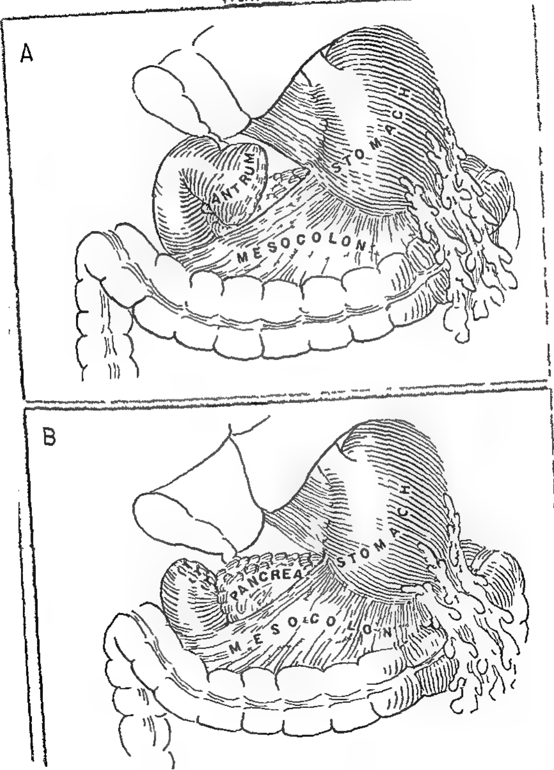
A —The abdomen has been opened To identify the ulcer the gastrojejunostomy has been exposed in this instance by elevation of the mesocolon since the anastomosis is posterior Locally the manifestations of an ulcer may vary from an apparently normal jejunum to an alarming involvement of all the structures about the anastomosis Usually however an area of localized induration with some stippling of the serosa can be observed on the efferent jejunal loop about 1 cm distal to the anastomosis The rest of the upper abdomen is then explored In this case it is found that the stomach had been divided and turned in proximal to the pylorus In addition the gastric resection had been conservative with almost half the stomach still in place

B —The pyloric antrum has been mobilized and resected using the same technic that is outlined for the second stage of the two stage gastrectomy (Plate 47)

The simple procedure is emphasized because a higher gastric resection or a vagotomy would be totally ineffective if any of the antral mucosa is still in situ Retained antral mucous membrane has been encountered in three groups of cases (1) those in which the primary operation was done under stress or great difficulty for example for acute massive hemorrhage (2) those in which a Bancroft operation had been done with incomplete removal of the mucous membrane and (3) those in which operation had been done in another hospital and the details of the procedure were hazy or unavailable

[Anastomotic ulcer *continued on page 348*]

PLATE 73



Resection of Stomach and Jejunum

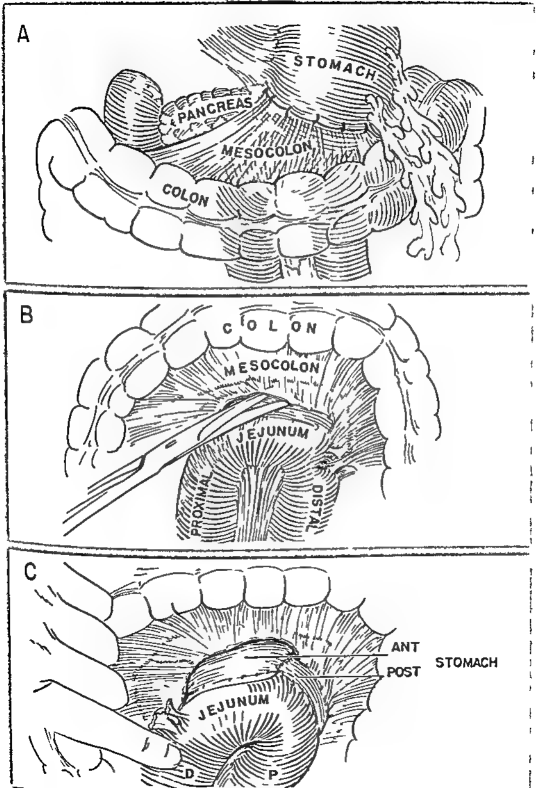
In this instance the anastomotic ulcer has followed a gastric resection that had been too conservative In the figures, for the sake of clarity the omentum has been omitted The procedure that will be done is a resection of the gastrojejunostomy and ulcer an end to-end anastomosis of the jejunum a higher gastric resection and a gastroenterostomy During the dissection if the surgeon finds orientation difficult he must remember he is simply reversing certain steps of the original gastric resection This difficulty arises only if the original anastomosis has been postcolic and it is this type that will be illustrated

A —Adhesions of the omentum have been freed It has been ascertained that the pyloric antrum and pylorus were removed completely at the original operation The attachment of the mesocolon to the stomach is viewed from above

B —The transverse colon has been elevated demonstrating the line of attachment of the mesocolon to the stomach and, just below it, the gastrojejunostomy The ulcer is shown just distal to the anastomosis The stomach is now freed from the mesocolon, beginning on the anterior wall midway between the curvatures This dissection should be in an avascular plane at this point although as the curvatures are reached adventitious vessels will be encountered The dissection must be kept close to the gastric wall to avoid branches of the midcolic artery

C —When the anterior surface of the stomach has been freed the distal loop of jejunum is brought forward and to the right This rotates the posterior wall of the stomach so that it can be dissected from its attachment to the mesocolon

[Resection for anastomotic ulcer *continued on page 350*]


A
STOMACH
PANCREAS
MESOCOLON
COLON
B
COLON
MESOCOLON
JEJUNUM
PROXIMAL
DISTAL
C
ANT
POST
STOMACH
JEJUNUM
D
P

Resection of Stomach and Jejunum

In this instance the anastomotic ulcer has followed a gastric resection that had been too conservative In the figures for the sake of clarity the omentum has been omitted The procedure that will be done is ■ resection of the gastrojejunostomy and ulcer an end to end anastomosis of the jejunum a higher gastric resection and ■ gastroenterostomy During the dissection if the surgeon finds orientation difficult he must remember he is simply reversing certain steps of the original gastric resection This difficulty arises only if the original anastomosis has been postcolic and it is this type that will be illustrated

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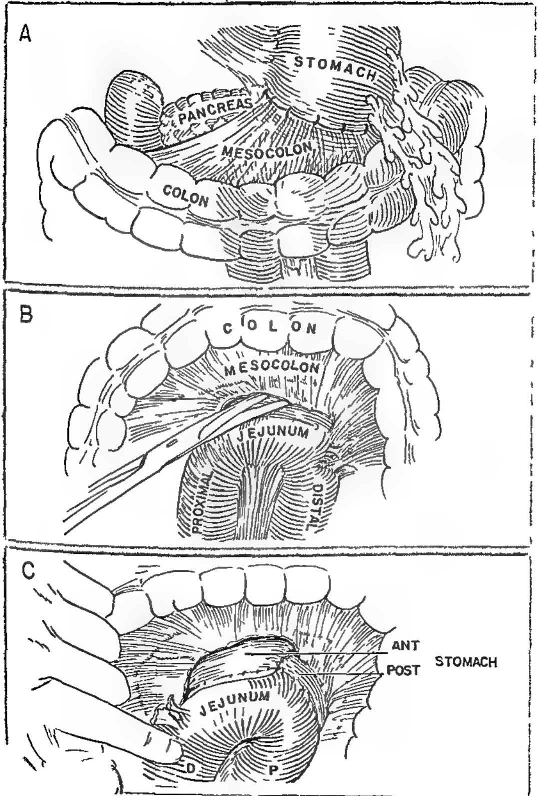
C —When the anterior surface of the stomach has been freed, the distal loop of jejunum is brought forward and to the right This rotates the posterior wall of the stomach so that it can be dissected from its attachment to the mesocolon

[Resection for anastomotic ulcer *continued on page 350*]

PLATE 74


A
STOMACH
PANCREAS
MESOCOLON
COLON
B
COLON
MESOCOLON
JEJUNUM
PROXIMAL
DISTAL
C
ANT
POST
STOMACH
JEJUNUM
D
P

Resection of Stomach and Jejunum

In this instance the anastomotic ulcer has followed a gastric resection that had been too conservative In the figures, for the sake of clarity, the omentum has been omitted The procedure that will be done is a resection of the gastrojejunostomy and ulcer an end to-end anastomosis of the jejunum a higher gastric resection and a gastroenterostomy During the dissection if the surgeon finds orientation difficult he must remember he is simply reversing certain steps of the original gastric resection This difficulty arises only if the original anastomosis has been postcolic and it is this type that will be illustrated

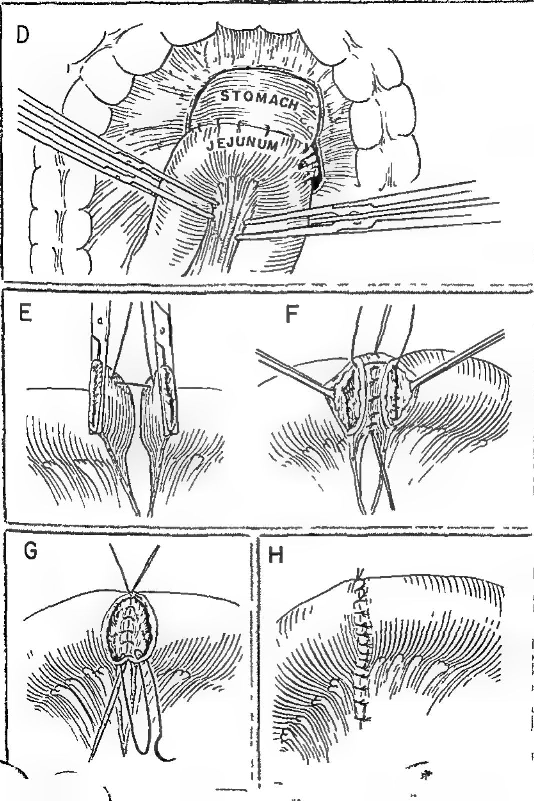
A —Adhesions of the omentum have been freed It has been ascertained that the pyloric antrum and pylorus were removed completely at the original operation The attachment of the mesocolon to the stomach is viewed from above

B —The transverse colon has been elevated demonstrating the line of attachment of the mesocolon to the stomach and just below it, the gastrojejunostomy The ulcer is shown just distal to the anastomosis The stomach is now freed from the mesocolon beginning on the anterior wall midway between the curvatures This dissection should be in an avascular plane at this point, although as the curvatures are reached adventitious vessels will be encountered The dissection must be kept close to the gastric wall to avoid branches of the midcolic artery

C —When the anterior surface of the stomach has been freed the distal loop of jejunum is brought forward and to the right This rotates the posterior wall of the stomach so that it can be dissected from its attachment to the mesocolon

[Resection for anastomotic ulcer *continued on page 350*]

PLATE 74



D —The stomach has been separated completely from the meso colon The jejunum is now grasped with two pairs of Allen clamps placed through normal jejunum of the afferent and efferent loops The jejunum and its mesentery are divided

E —An end to end jejunojejunostomy is then made The outer layer of interrupted Lembert sutures of cotton or silk is placed and the sutures tied

F —The inner layer is of continuous 00 catgut If the jejunal lumen is small it is best to use a lock stitch or interrupted sutures to avoid any constriction This precaution is particularly necessary when the jejunal ulcer has followed a gastroenterostomy and the gastric resection is being done for the first time any obstruction at this anastomosis would then lead to a blowout of the duodenal stump

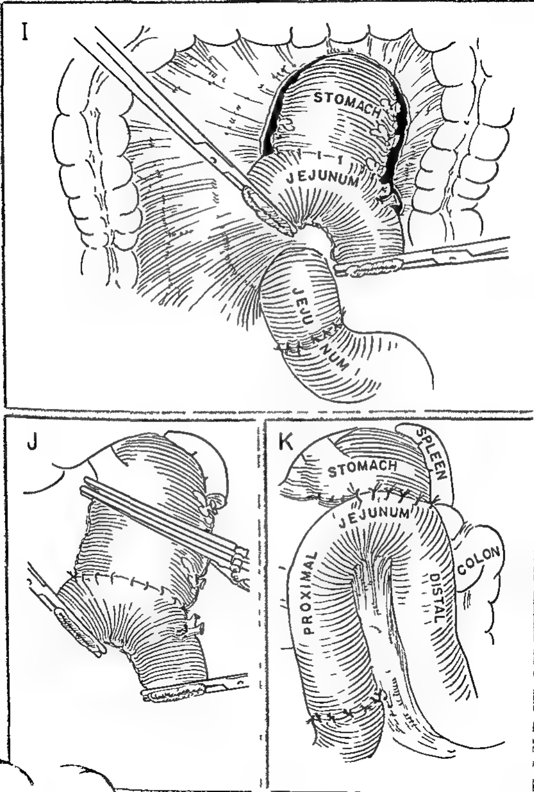
G —The posterior inner suture has been completed and locked and is being continued around the lower angle

H —Both anterior layers have been completed and the defect in the mesentery closed This completes the jejunojejunostomy Though this anastomosis can be made in any of several ways it is important that an adequate lumen be maintained and that any torsion on the mesentery be avoided This can be accomplished best by an open end to end anastomosis

It will be found that the dismantling of a gastroenterostomy is comparatively simple if it has been antecolic in type With postcolic anastomoses however the procedure is apt to be difficult and bloody particularly if an anastomotic ulcer is present and the afferent jejunal loop is short The middle colic vessels must be guarded carefully under these circumstances

In certain cases it will be found that the jejunum at the line of anastomosis to the stomach is so wide that it is not necessary to resect the whole jejunum Rather the stoma can be dismantled and the rent in the jejunum closed with two layers of sutures

[Resection for anastomotic ulcer *continued on page 352*]

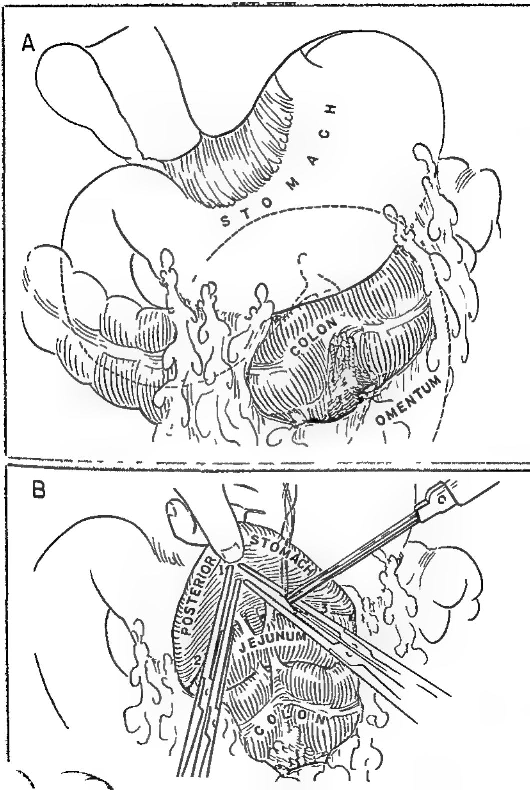

I
STOMACH
JEJUNUM
JEJUNUM
J
K
STOMACH
SPLEEN
JEJUNUM
COLON
PROXIMAL
DISTAL

I—The situation at the close of the jejunojejunostomy is shown It is apparent that if the previous gastrojejunostomy was done with a short loop the jejunojejunostomy will lie close to the ligament of Treitz The stomach and attached jejunum are now pulled up through the transverse mesocolon

J—A radical subtotal gastric resection is now carried out leaving not over 25 per cent of the estimated original volume of the stomach

K—It now must be decided whether an ante or postcolic anastomosis is to be done Usually the inflammatory change accompanying the jejunal ulcer and the operative trauma will make an antecolic anastomosis advisable If so the rent in the mesocolon is closed In the rare instance in which a postcolic anastomosis is used the mesocolon is anchored to the stomach wall in the usual fashion A Hofmeister anastomosis is made and the abdomen closed

Complications of anastomotic ulcer—Brief mention should be made of the important complications of anastomotic ulcers *Perforation* of a jejunal ulcer may be the first indication that such an ulcer is present The best operation if conditions are optimum is immediate resection of the stomach and jejunum If it is the surgeon's opinion that this operation will not be tolerated closure of the perforation is necessary Suture of the perforation must be done in such a way that the lumen of the jejunum is not constricted The closure is reinforced by a tab of omentum A strict medical regimen must be followed after operation and a resection performed 8–12 weeks later *Hemorrhage* varies considerably in frequency and magnitude A fatal outcome is not uncommon since large vessels may be eroded in the jejunal mesentery If operation is required for an exsanguinating hemorrhage the ulcer must be resected since bleeding cannot be controlled in any other way A *gastrojejunocolic fistula* may result from erosion into the colon The presence of an anastomotic ulcer should always raise the question of some other underlying disease of the ductless gland In particular the Zollinger Ellison syndrome (Section 21) or hyperparathyroidism must be considered


A
STOMACH
COLON
OMENTUM
B
STOMACH
POSTERIOR
JEJUNUM
COLON
1
2
3
4

ONE STAGE TECHNIC

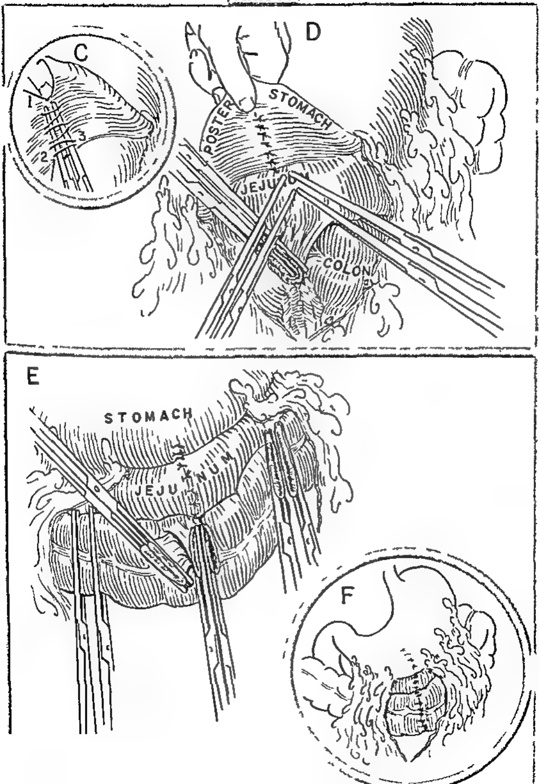
This is the operation of choice since the period of hospitalization is comparatively short However the patient should be in a state of good nutrition and without evidence of severe enteritis After several days of careful preparation the abdomen is opened through a left paramedian incision *The best operation will involve closure of the colonic fistula by suture or resection* followed by the same steps as those outlined in Plate 74 In Plate 75 the minimal operation consisting of dismantling of the fistula and gastrojejunostomy will be illustrated

A —The fistula nearly always follows a posterior gastroenterostomy The inflammatory reaction about the fistula often is surprisingly *slight with only a small section of colon involved There is usually* no evidence of active duodenal ulcer at this time If extensive inflammatory reaction is encountered it is better to carry out either Pfeiffer's or Lahey's operation (Plates 76 and 77) otherwise the one stage resection is started The gastroepiploic vessels are divided on either side of the gastroenterostomy stoma and the omentum is freed *from the colon*

B —The stomach is now elevated exposing the fistula The surgeon may decide that it is safe to excise the fistula and resect the stomach at the present operation If so the transverse colon may be divided between Allen clamps leaving the fistula attached to the jejunum Further steps in the resection are then the same as *those outlined for resection of gastrojejunal ulcer* (Plate 74) If however it is possible that the patient will not tolerate a gastric resection at this time a wedge of stomach that includes the gastrojejunostomy stoma is excised next Two pairs of Allen clamps are applied on the posterior wall of the stomach as a shallow V (*2 1 3*) on either side of the stoma *The stomach is then divided with the cautery*

[One stage technic *continued on page 356*]

PLATE 75



C.—The stomach is closed with two layers of sutures. This closure may be effected in either of two ways. The method shown in Plate 57 may be used, or the clamps on the stomach may be brought together as shown here. Then a running catgut suture is started at *1* and knotted. It is carried in a running Cushing suture that catches only the anterior wall loosely over both clamps down to points *2* and *3*. The handles of the clamps are elevated and a similar stitch applied on the posterior stomach wall. The clamps are removed as the sutures are tied together.

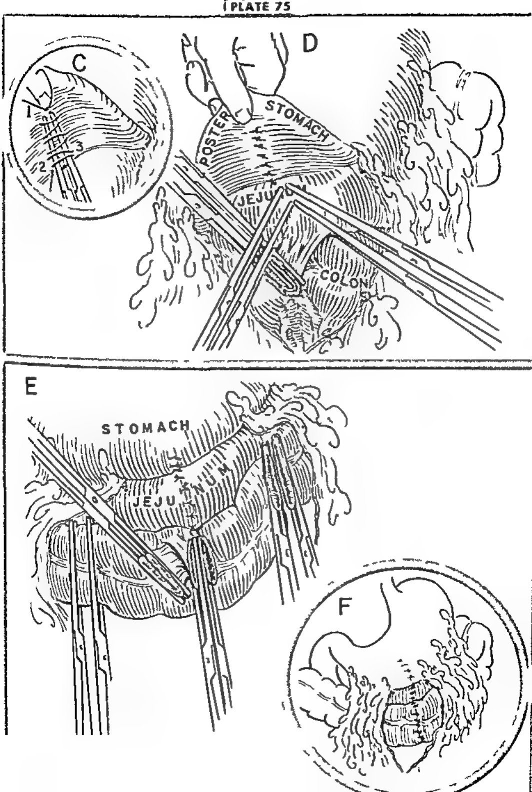
D.—A second layer of sutures has finished closure of the stomach. The jejunocolic fistula is now separated from the jejunum. Two pairs of Allen clamps are applied to the jejunum on either side of the fistula and the segment of jejunum excised. The jejunum is now left with two defects—that of the gastroenterostomy stoma and that of the jejunocolic fistula. If the openings are small and the jejunum of good caliber, it is possible to trim the margins of the old stoma and close the jejunum. If there is any question of blood supply or of obliteration of the jejunal lumen, it is better to resect the jejunum with the two defects and do a two layer end to end anastomosis.

E.—In this instance the colon is involved so near the mesentery that the short section will be resected.

F.—Continuity of the colon has been re established by a two layer anastomosis.

If the operation has gone smoothly, the surgeon still may reconsider and proceed with a 75 per cent gastric resection. Otherwise definitive surgical treatment of the duodenal ulcer must be carried out in three to four months or the duodenal ulcer will reactivate.

[Gastrojejunal fistula *continued on page 358*.]


C
1
2
3
D
POSTER
STOMACH
JEJUNUM
COLON
E
STOMACH
JEJUNUM
F

Pfeiffer's Method

A—At the first stage the abdomen is explored and a loop colostomy performed in the ascending colon It is desirable to have the colostomy as high as possible and still not interfere with the later resection of the fistula

This procedure excludes the contents of the colon from the stomach and small intestine and allows the enteritis and gastritis to subside Very shortly discharge of gastric contents through the fistula ceases and the distal colon can be irrigated regularly and thoroughly cleansed

B—The second stage is performed three to four months later when the patient's nutrition has improved At this time, two choices are open to the surgeon One consists of excision of the fistula with repair of the stomach jejunum and colon The other involves simultaneous gastric resection In this figure the various viscera have been repaired reserving gastric resection for a later date

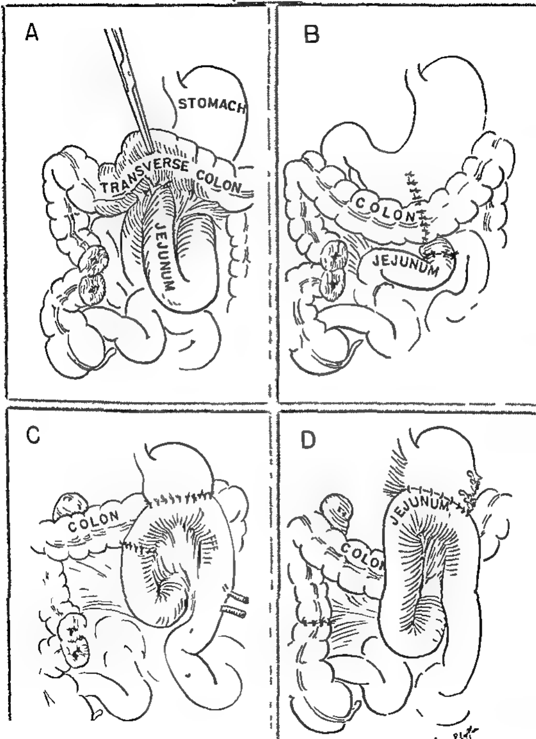
C—The preferable second stage operation is excision of the fistula and gastric resection It will usually be found that inflammation and shortening of the mesocolon make an anterior anastomosis preferable A double jejunostomy (Plate 70) is advisable since the postoperative course is likely to be stormy

D—The third stage consists of closure of the colostomy and is done two to three weeks after the second stage when convalescence is well established Resection of the colonic stoma with a two layer, open end to end anastomosis is preferable

REFERENCE Pfeiffer

[Gastrojejunal fistula *continued on page 360*]

PLATE 76


A
STOMACH
TRANSVERSE COLON
JEJUNUM
B
COLON
JEJUNUM
C
COLON
D
JEJUNUM
COLON

Pfeiffer's Method

A—At the first stage the abdomen is explored and a loop colostomy performed in the ascending colon It is desirable to have the colostomy as high as possible and still not interfere with the later resection of the fistula

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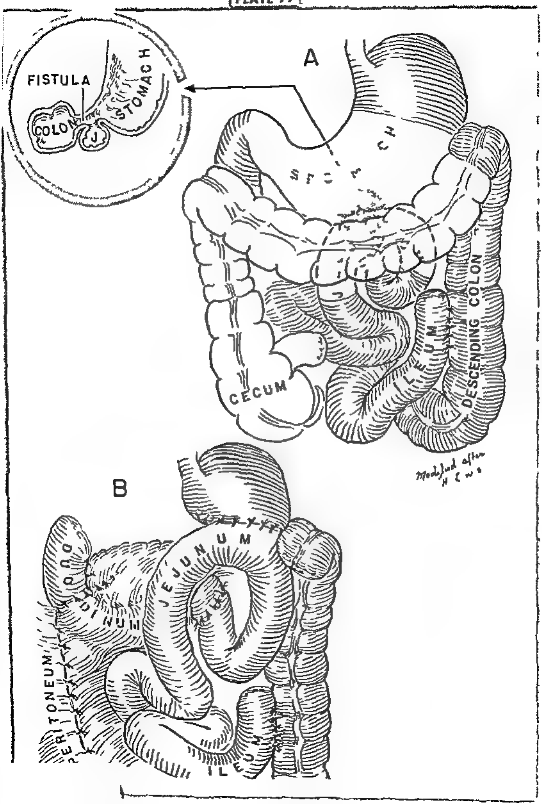
D—The third stage consists of closure of the colostomy and is done two to three weeks after the second stage when convalescence is well established Resection of the colonic stoma with a two layer open end to end anastomosis is preferable

REFERENCE Pfeiffer

[Gastrojejunal fistula *continued on page 360*]

PLATE 77


A
FISTULA
STOMACH
COLON
J
STOMACH
CECUM
DESCENDING COLON
ILEUM
B
JEJUNUM
DUODENUM
PERITONEUM
ILEUM

Lahey's Method

Lahey has devised a two stage method for the removal of a gastro jejunocolic fistula that does not require a colostomy

A —At the first stage, the terminal ileum is divided and an ileo colostomy performed between the ileum and the descending colon

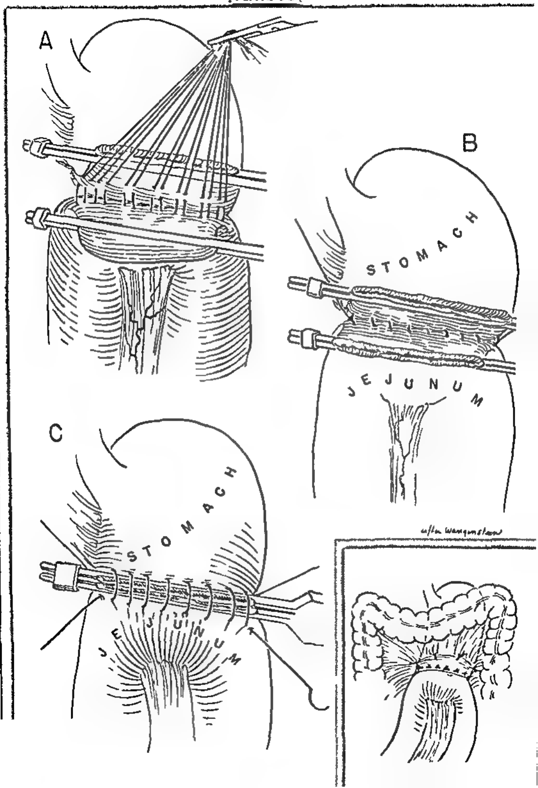
B —The second stage is carried out two or three months later A block resection of the distal ileum cecum ascending and transverse colon to the right of the fistula involved jejunum and lower three fourths of the stomach is performed An end to end jejunojejunostomy and an anastomosis between stomach and jejunum complete the operation

This operation has several disadvantages It does not exclude co lonic contents completely from the fistula with the result that prepa ration of the patient is not as satisfactory as with Pfeiffer s operation The second stage is a difficult technical procedure and sacrifices a long section of colon unnecessarily

Other staged operations have been described such as the exterior ization of the two ends of the colon after excision of the fistula with closure of the colostomy at a later date

Antibiotics have contributed significantly to the surgery of these fistulas since by preparation of the intestinal tract with neomycin or Sulfathalidine nearly all procedures can be carried out in one stage and the cumbersome staged operations can be avoided

REFERENCES Lahey and Swinton Marshall


A
B
STOMACH
JEJUNUM
C
STOMACH
JEJUNUM
after Wangensteen

SECTION 20

Anastomoses with Special Clamps

Wangensteen's Aseptic Anastomosis

Wangensteen has applied the principles of aseptic anastomosis to the stomach He has devised a strong clamp with a narrow blade that will invert only a small diaphragm of stomach and jejunum

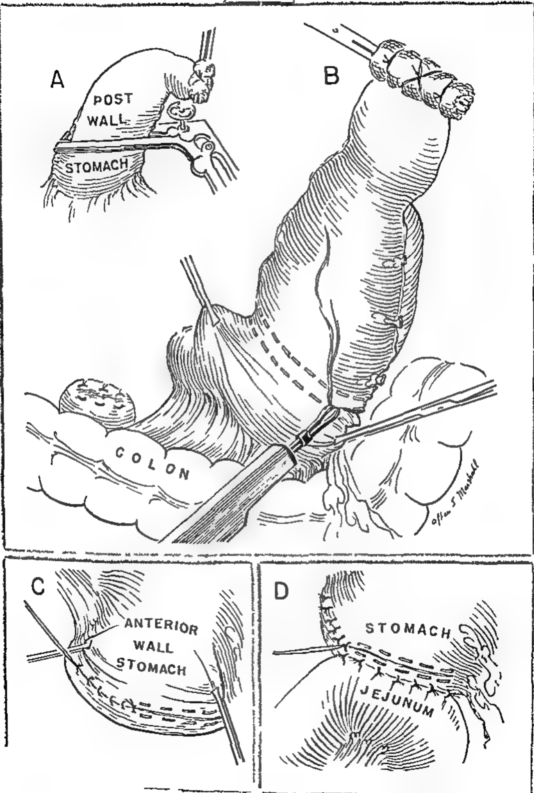
A —The gastric resection has been completed The proximal stomach has been removed Thorough cauterization of the cut end is necessary since much of the hemostasis depends on it A second clamp has been placed on the jejunum The posterior walls of the stomach and jejunum are united with a row of interrupted silk Halsted sutures This row should not be over 1 cm from the clamps in order to turn in a small diaphragm These sutures are tied and cut

B —A second posterior row of continuous chromic catgut is placed and tied at both ends The ends are left long The row is inserted as close to the clamps as possible The antimesenteric margin of the jejunum is then excised with the cautery close to the clamp

C —The clamps are rotated inward exposing the anterior walls of stomach and then are locked in position A running Cushing suture of catgut is then taken over the clamps uniting anterior walls of stomach and jejunum This suture is applied loosely and is then tightened as the clamps are unlocked and withdrawn The ends of the suture are tied to the long ends of the posterior inner row

D —The outer anterior row of Halsted sutures of silk has finished the anastomosis Patency of the anastomosis is established by palpation with the thumb and index finger

Wangensteen and associates find this type of anastomosis very successful Despite the lack of ligature of individual blood vessels postoperative hemorrhage has not occurred We have not used the method feeling that advantages of open anastomosis far outweigh its dangers


A
POST
WALL
STOMACH
B
COLON
C
ANTERIOR
WALL
STOMACH
D
STOMACH
JEJUNUM

The von Petz clamp may be used for any type of partial gastrec tomy The operation is carried out in the manner illustrated in pre vious plates except for the details noted here

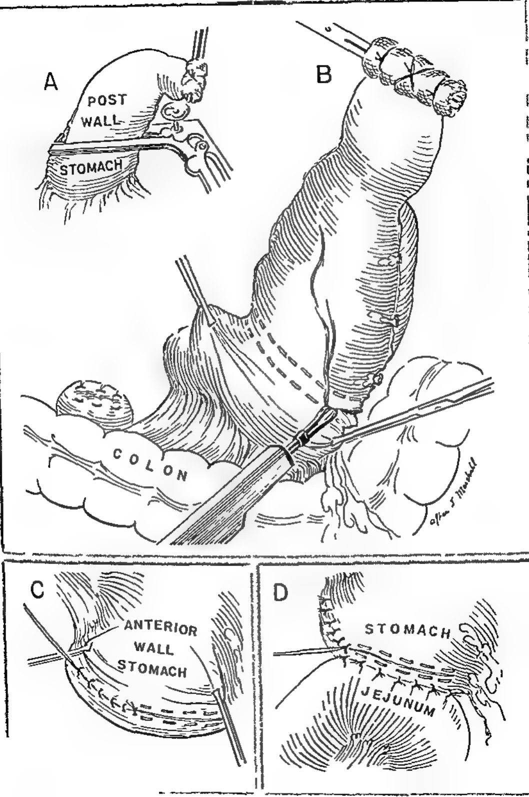
A —In this instance the clamp is being used in conjunction with a partial distal gastrectomy for duodenal ulcer The stomach has already been mobilized and the duodenum divided The duodenum has been inverted The clamp is then applied at the level of division of the stomach As the thumb screw is turned the two rows of metal clips are set closing the stomach

B —The proximal stomach is stabilized by two Allis clamps and the stomach divided with the cautery

C —The upper end of the stomach is to be inverted in prepara tion for a Hofmeister anastomosis The upper half of the cut end of the stomach will be inverted with two layers of sutures The first row a running 00 catgut has inverted half of the clips

D —A second row of interrupted nonabsorbable sutures completes the inversion of the upper end The jejunum then is sutured to the posterior wall of the stomach along the lower half of the cut end Since the row of clips will be excised this suture line must be placed on the gastric wall about 1 cm proximal to the clips The anastomosis will be made of an outer row of interrupted nonabsorbable sutures and an inner row of continuous 00 catgut In this figure the outer posterior row has been completed

[Gastrectomy with von Petz clamp *continued on page 366*]


A
POST
WALL
STOMACH
B
COLON
C
ANTERIOR
WALL
STOMACH
D
STOMACH
JEJUNUM

 Gastrectomy with von Petz Clamp

The von Petz clamp may be used for any type of partial gastrectomy The operation is carried out in the manner illustrated in previous plates except for the details noted here

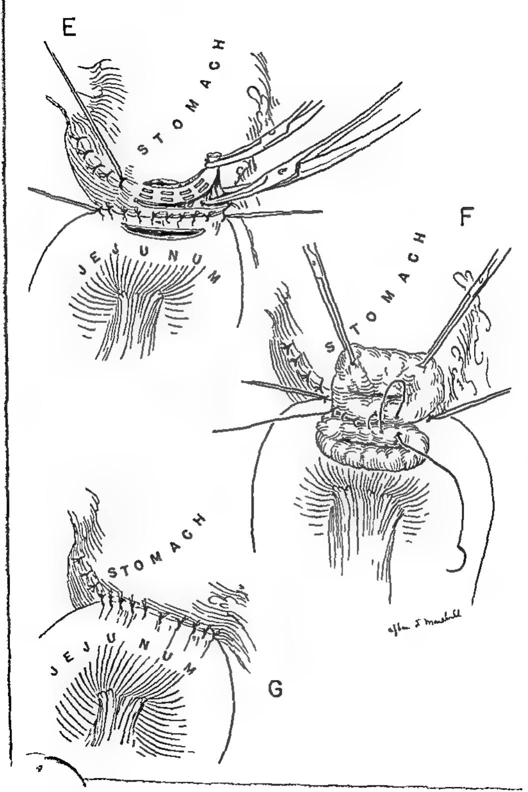
A—In this instance the clamp is being used in conjunction with a partial distal gastrectomy for duodenal ulcer The stomach has already been mobilized and the duodenum divided The duodenum has been inverted The clamp is then applied at the level of division of the stomach As the thumb screw is turned the two rows of metal clips are set closing the stomach

B—The proximal stomach is stabilized by two Allis clamps and the stomach divided with the cautery

C—The upper end of the stomach is to be inverted in preparation for a Hofmeister anastomosis The upper half of the cut end of the stomach will be inverted with two layers of sutures The first row a running 00 catgut has inverted half of the clips

D—A second row of interrupted nonabsorbable sutures completes the inversion of the upper end The jejunum then is sutured to the posterior wall of the stomach along the lower half of the cut end Since the row of clips will be excised this suture line must be placed on the gastric wall about 1 cm proximal to the clips The anastomosis will be made of an outer row of interrupted nonabsorbable sutures and an inner row of continuous 00 catgut In this figure the outer posterior row has been completed

[Gastrectomy with von Petz clamp *continued on page 366*]


E
STOMACH
JEJUNUM
F
STOMACH
STOMACH
JEJUNUM
G

E—The jejunum is opened and hemostasis secured The row of clips at the site of anastomosis is then excised with the scissors so that normal stomach will be used for the anastomosis

F—The posterior inner suture line is being inserted The same suture will be continued anteriorly as a Connell suture to form the inner row

G—The anastomosis has been completed with an outer anterior row of interrupted sutures

There are numerous objections to the use of the von Petz clamp Although it is an ingenious machine time is required to prepare it for use before each operation Since half of the clips on the upper end of the stomach will be excised there is a good deal of waste motion Finally the fate of the retained metal along the upper portion of the lesser curvature is open to question Erosions and ulcers may form over the clips For these reasons most surgeons do not approve of the use of this clamp

Many other clamps have enjoyed limited popularity for gastric resection Most tend to reduce the open technic to a partially aseptic procedure Experience has shown that true aseptic technics are not easy to obtain or necessary in gastric surgery Whereas widespread contamination of the operative field from an open stomach is to be deplored it still is true that peritonitis does not result from minimal contamination but from inaccurate insecure suture lines lack of blood supply or tension on the suture line Particularly in the stomach large blood vessels make accurate hemostasis essential For these reasons open anastomoses are recommended for gastric surgery in this text Rarely a poorly prepared colon must be resected in conjunction with the stomach in this case a Parker Kerr anastomosis of the colon may be used

REFERENCES Marshall von Petz Parker and Kerr

total gastrectomy should be avoided because of the gastric crippling which may follow

Unusual inflammatory lesions.—*Suppurative gastritis* or acute phlegmonous gastritis is a rare disease that theoretically should respond to antibiotic therapy. In the past it was observed most commonly in the course of a streptococcic bacteremia. Early operation with excision of a localized gastric abscess led to survival in a few reported cases. In a variant of this disease, acute emphysematous gastritis, uneventful recovery has followed antibiotic therapy (Welch and Jones). *Syphilis* of the stomach has been treated by resection. The lesion mimics carcinoma, and differentiation is seldom desirable except on the basis of pathological study. *Tuberculosis* may occur in the stomach and be manifested by pyloric obstruction or bleeding.

Linitis plastica may be the end result of a nonspecific chronic inflammatory process or of syphilis, although it usually is due to cancer. Symptoms are those of malnutrition and anemia, and diagnosis is made on the characteristic pathological appearance. Treatment should be based on the assumption that the patient has cancer of the stomach, for which total gastrectomy is indicated.

Hiatus hernia, reflux esophagitis and duodenal ulcer.—Numerous methods have been recommended by various surgeons for relief of the complications of reflux esophagitis. These include (1) subtotal distal gastrectomy (Wangensteen and Levin), (2) esophagogastrectomy (Sweet), in which either a limited or an extensive partial proximal gastrectomy is used, (3) esophagogastrectomy with exclusion of the stomach (Allison), (4) interposition of a jejunal loop between the esophagus and stomach after esophagogastrectomy (Merendino), (5) limited proximal esophagogastrectomy, bilateral vagotomy and resection of the antrum (Ellis, Anderson and Clagett), and (6) pyloroplasty alone (Lischer and Burford). The multiplicity of proposed methods suggests that no one method is applicable in all cases and that none has a clear superiority.

In the usual case in which duodenal ulcer is combined with a hiatus hernia and reflux esophagitis, a logical treatment appears to be one which combines abdominal repair of the hiatus hernia with definitive treatment of the ulcer diathesis, either by subtotal gastrectomy or by vagotomy combined with antral exclusion or distal gastrectomy (Plate 80). When the esophagitis is severe and obstruction

SECTION 21

Rare Diseases of the Stomach

IN THIS SECTION brief consideration will be given to the surgical aspects of the more unusual lesions of the stomach. Since this is a miscellaneous group, no attempt will be made to classify them or to present them in order of their comparative importance.

GASTRITIS.—The subject of gastritis is exceedingly complex and is complicated more by the fact that the gross diagnosis, as seen through the gastroscope, has little correlation with pathological findings, as proved by Benedict. The surgeon, however, is interested particularly in only two of these manifestations, namely, gastritis that is the cause of acute hemorrhage and giant gastritis.

Gastritis may be followed by hemorrhage serious enough to require operation, especially if there has been a high alcohol or aspirin intake. If bleeding is believed to be due to gastritis and emergency x-rays show no ulcer, a conservative course is followed. If continuing hemorrhage forces surgery, the stomach is opened to search for a bleeding point. In some cases the area of erosive gastritis will be sharply localized and can be treated by local excision. In others nearly the whole gastric mucosa may be involved. Subtotal resection plus a limited devascularization of the fundus has been successful in this situation. In some instances in our hospital recurrent hemorrhage has forced an essentially total gastrectomy within a few days. Mixter and Hinton have been impressed by the addition of vagotomy.

Giant gastritis is manifested by huge gastric folds which may lead to extensive gastric secretion, secondary duodenal ulcer, diarrhea, and hypoproteinemia. Though apparently of no importance as a premalignant lesion, it may be confused with lymphoma or carcinoma on the x-ray films. Subtotal gastrectomy may be required, but

total gastrectomy should be avoided because of the gastric crippling which may follow

UNUSUAL INFLAMMATORY LESIONS —*Suppurative gastritis* or acute phlegmonous gastritis is a rare disease that theoretically should respond to antibiotic therapy In the past it was observed most commonly in the course of a streptococcic bacteremia Early operation with excision of a localized gastric abscess led to survival in a few reported cases In a variant of this disease acute emphysematous gastritis uneventful recovery has followed antibiotic therapy (Welch and Jones) *Syphilis* of the stomach has been treated by resection The lesion mimics carcinoma and differentiation is seldom desirable except on the basis of pathological study *Tuberculosis* may occur in the stomach and be manifested by pyloric obstruction or bleeding

Linitis plastica may be the end result of a nonspecific chronic inflammatory process or of syphilis although it usually is due to cancer Symptoms are those of malnutrition and anemia and diagnosis is made on the characteristic pathological appearance Treatment should be based on the assumption that the patient has cancer of the stomach for which total gastrectomy is indicated

HIATUS HERNIA REFLUX ESOPHAGITIS AND DUODENAL ULCER —Numerous methods have been recommended by various surgeons for relief of the complications of reflux esophagitis These include (1) subtotal distal gastrectomy (Wangensteen and Levin) (2) esophagogastrectomy (Sweet) in which either a limited or an extensive partial proximal gastrectomy is used (3) esophagogastrectomy with exclusion of the stomach (Allison) (4) interposition of a jejunal loop between the esophagus and stomach after esophagogastrectomy (Merendino) (5) limited proximal esophagogastrectomy bilateral vagotomy and resection of the antrum (Ellis Anderson and Clagett) and (6) pyloroplasty alone (Lischer and Burford) The multiplicity of proposed methods suggests that no one method is applicable in all cases and that none has a clear superiority

In the usual case in which duodenal ulcer is combined with a hiatus hernia and reflux esophagitis a logical treatment appears to be one which combines abdominal repair of the hiatus hernia with definitive treatment of the ulcer diathesis either by subtotal gastrectomy or by vagotomy combined with antral exclusion or distal gastrectomy (Plate 60) When the esophagitis is severe and obstruction

a prominent feature a resection of this area will be necessary The possibility of a coexisting carcinoma of the esophagus must not be forgotten

In *A* treatment of esophagitis hiatus hernia and duodenal ulcer by repair of the hiatus hernia and subtotal distal gastrectomy is illustrated Ellis Anderson and Clagett s operation is shown in *B* and *C* The stippled areas in *B* are the areas to be resected *C* shows the appearance at the end of operation after bilateral vagotomy, esophagogastrostomy and gastroduodenostomy

Since a more detailed discussion of the treatment of esophagitis is beyond the scope of this volume the reader is referred to the articles of Sweet and of Ellis Anderson and Clagett

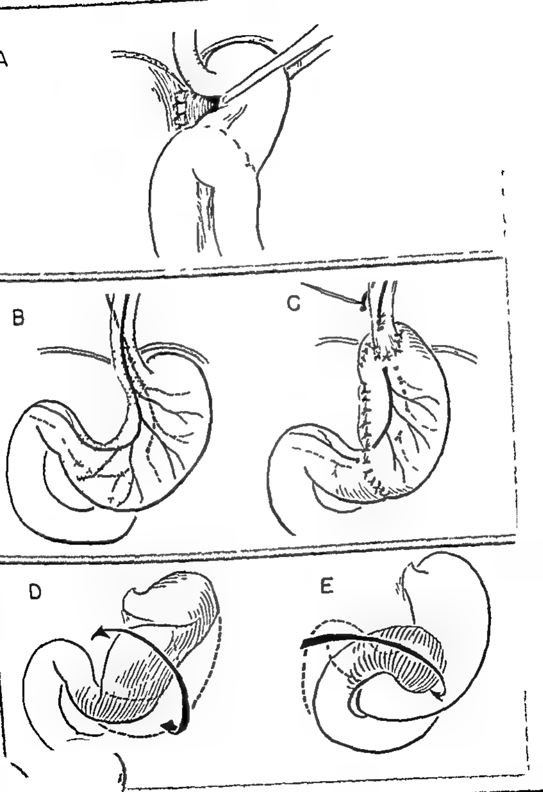
Volvulus—Volvulus of the stomach is unusual but when it occurs the onset is usually dramatic and the outcome may be fatal unless operation is carried out rapidly To allow a volvulus the stomach must be relatively mobile Most frequently volvulus occurs in association with a parahiatal hernia but it may be secondary to adhesions The volvulus may be total or partial

Two types are described In volvulus organoaxialis, illustrated in *D* the axis of rotation is a line drawn from esophagus to pylorus the greater curvature usually passes anterior to the lesser although the reverse may be true Volvulus mesenterioaxialis shown in *E* is somewhat more common the axis passes from the middle of the lesser curvature to the middle of the greater In this type the pylorus usually rotates anterior to the cardia, though it may rotate posteriorly

Treatment of the volvulus will depend upon the individual circumstances including the degree of vascular embarrassment encountered in the stomach Possible procedures include reduction of the volvulus repair of a parahiatal hernia fixation of the stomach or a sleeve resection combined with fixation Preliminary evacuation of the stomach with a suction trocar may be necessary before the pathology can be clarified

Gastric and Duodenal Lesions Associated with Endocrine Dysfunction—A number of interesting syndromes which fall into this pattern are being recognized

1 The adrenal glands have been shown by Gray and others to have an important influence on the development of peptic ulcer Cortisone induced ulcers are not rare and the aggravation of a


A
B
C
D
E

known peptic ulcer by cortisone occurs so frequently that the presence of an ulcer contraindicates such therapy The surgeon now sees such patients most commonly because of gastric hemorrhage If it is possible to stop the corticoid therapy the ulcer usually will heal In many instances the therapy must be continued and persisting hemorrhage may require emergency surgery The same principles apply as in the usual cases of bleeding ulcer except that continuous support by cortisone must be given before during and after operation Usually 100 mg of hydrocortisone is given shortly before operation and a continuous drip employed during the procedure About twice the patient's daily dose is given for the next three to four days and then the dosage is tapered off gradually

2 Hyperparathyroidism is now known to be associated with duodenal ulcer quite commonly Cope believes the presence of any peptic ulcer and especially an anastomotic ulcer demands study of the calcium and phosphorus serum levels This relationship is far more than coincidental since nearly half the patients with hyperparathyroidism will have had an ulcer at some time In a few instances ulcer symptoms have subsided after removal of a parathyroid adenoma

3 The Zollinger Ellison syndrome is caused by pancreatic islet cell adenomas or carcinomas associated with excessive amounts of gastric secretion of high acidity and the formation of ulcers in unusual locations such as the jejunum distal duodenum or esophagus Tumors of other ductless glands are also commonly found Since these patients are almost always operated on originally for peptic ulcer it is desirable for the surgeon to examine the pancreas at the time of an elective operation for ulcer Needless to say this must be done with care or a traumatic pancreatitis may be produced The majority of the pancreatic lesions are malignant, but usually of a low grade At any rate removal of the tumor is essential if the abnormal gastric secretion is to be controlled In a series of 24 cases summarized by Ellison the tumor in 20 proved to be in the body or tail of the pancreas

PROLAPSE OF ANTRAL MUCOSA —Prolapse through the pylorus can often be observed on x rays It is usually small and only of academic interest but the presence of pain bleeding or obstruction has led to operation local excision of the prolapsing folds or a limited gastric resection has then been performed.

PYLORIC HYPERTROPHY —*Pyloric muscle hypertrophy in the adult* may be found with or without a near by gastric ulcer and usually is manifested by partial pyloric obstruction Some cases probably represent persistence of the infantile form into adult life Others are believed to develop at a later time and may be secondary to irritation and spasm or to an ulcer Since grossly this lesion closely resembles a small carcinoma of the pylorus and since associated ulcers are common a gastric resection is advisable when this lesion is encountered at operation

RUPTURE —Rupture of the stomach or lower esophagus usually follows blunt trauma but may be due to vomiting or may occur spontaneously Signs of perforation or of hemorrhage may appear The presence of a hiatus hernia may lead to rupture within the left chest so that the signs of a gastric perforation may be limited to the chest Early operation with repair of the defect is indicated

BEZOARS —Although bezoars of many types appear in the stomach special mention should be made of the trichobezoars which produce a characteristic syndrome of inanition a palpable epigastric mass and a typical x ray picture Portions of the bezoar may break off and cause intestinal obstruction The bezoar should be removed through a gastrotomy incision

UNUSUAL TUMORS OF THE STOMACH —The various types of lymphoma comprise between 1 and 2 per cent of all malignant gastric tumors and are characteristically bulky tumors that are particularly likely to occur in the fundus Wide extirpation usually by total gastrectomy should be followed by radiation therapy

The malignant forms of the spindle cell tumors—fibro leio and neurofibrosarcoma—also are more common in the fundus and are often manifested by massive hemorrhage A radical subtotal or total gastrectomy is indicated

Benign gastric tumors include polyps lipomas fibromas leiomyomas angiomas and pancreatic rests Rarely osteomas chondromas, dermoid cysts or hamartomas are found

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1 Early recognition and repair of lateral fistulas The finding of retroperitoneal extravasation of bile in an abdomen explored for trauma is diagnostic of a duodenal rupture that must be exposed and repaired The earlier after injury the fistula is repaired the better the chance of success Repair may be either by suture (Plate 16) or by sleeve resection (Plate 17) in the more severe cases Use of this method is limited essentially to the early repair of traumatic fistulas arising in the otherwise normal duodenum

2 Complete defunctioning of the upper duodenum by gastric resection and gastrojejunostomy This method is indicated if the fistula follows a perforated duodenal ulcer or trauma from biliary tract surgery A Bancroft type of resection supplemented by double jejunostomies (Plates 48 and 70) is best under these circumstances

3 Gastrojejunostomy This is a poor and ineffective method of accomplishing defunction even if supplemented by pyloric occlusion

4 *Jejunostomy In the poor risk patient this will allow the rein* troduction of Levin tube aspirate and aid in the maintenance of nutri tion Although jejunostomy is the least satisfactory operation of all it is the one most often used because the condition of the patient is usually so poor at the time of operation that nothing else can be done

A complete discussion of other features of therapy is beyond the scope of this volume A few salient facts will be noted The daily loss of fluid through the fistula may be 5–7 L with a corresponding loss of salt and potassium This must be replaced by intravenous injec tion or through the jejunostomy and the carbohydrate and protein required for the normal metabolism also given Digestion of the ab dominal wall is reduced by the use of continuous suction and by application of Gelusil or kaolin paste

Prognosis —End fistulas that follow blown-out duodenal stumps after gastrectomy usually cease to drain after 10–14 days Lateral fistulas above the level of the ampulla that are small usually close in about the same length of time If however there is profuse drain age it is best not to allow over a week to pass before converting the lateral to an end fistula since a large lateral fistula rarely closes spon taneously Lateral fistulas below the level of the ampulla carry a grave prognosis

REFERENCES Bartlett and Lowell Colp Albright and Leonard.

SECTION 22

Duodenal Fistula

DUODENAL FISTULAS arise from several causes of which the most important are trauma inflammation and tumors *Trauma* includes penetrating wounds from missiles blunt trauma for example from abdominal compression by a steering wheel in an automobile accident, and trauma as a sequence of certain inept operative procedures Thus fistulas may follow gastrectomy gallbladder surgery insecure closure of duodenotomy incisions or right colectomy or nephrectomy when the duodenum has been injured *Inflammatory* causes include duodenal ulcer and cholecystitis Tumors that involve the duodenum usually originate as carcinoma of the right colon

The fistulas may be internal or external Examples of internal fistulas are cholecystduodenal fistulas following erosion by a gallstone and duodenocolic fistulas secondary to carcinoma of the hepatic flexure Whereas these internal fistulas complicate any operative procedure they do not have the ominous significance of the external fistula in which the tremendous loss of fluids and electrolytes will cause death in a matter of days unless there is adequate replacement therapy

External fistulas are often described as either end or lateral in type End fistulas occur in the completely defunctioned duodenum after gastric resection of the Billroth II type Lateral fistulas occur in the duodenum that is still in continuity in the gastrointestinal tract It is obvious that fistulas will vary tremendously depending on their type and on the relationship to the ampulla of Vater

In general terms the treatment of these fistulas involves fluid and electrolyte replacement careful attention to the skin to prevent digestion and operation The operations that are of value are

a transthoracic approach it is important to eliminate as well as is possible the possibility of other lesions below the diaphragm Fortunately in our series bleeding peptic ulcers have been encountered only rarely in the presence of portal hypertension

TREATMENT —Variceal hemorrhage in contradistinction to that from ulcer nearly always is massive Consequently while in a few instances bleeding will subside spontaneously in most instances either tamponade or ligation is necessary to control the hemorrhage It is our belief that in any hemorrhage severe enough to require tamponade a ligation should be performed Essentials in treatment include (1) early tamponade as soon as it is clear that the bleeding is of major significance (2) early operation as soon as tamponade control is secured and before the balloon is released (3) prevention of ammonia intoxication by evacuation of the colon by laxatives and enemas and by the oral administration of antibiotics (4) special attention to support of liver function (5) performance of a shunt six weeks after ligation of varices or as soon thereafter as liver function is satisfactory

Surgeons in other institutions have used other approaches Child prefers balloon tamponade for immediate control and a portacaval shunt in two or three days before the balloon is deflated Some surgeons on discovering at laparotomy that bleeding is due to varices have had a tube passed by the anesthetist control is secured by inflation and an immediate shunt is performed At present none of these methods has a clear advantage over the others

Tanner has interrupted the venous reflux into the esophageal plexus by complete division of the stomach 5 cm below the cardia This is accompanied by division of vessels in the left gastric pedicle at that level After hemostasis has been secured the stomach is reconstituted by a two layer circular suture

SECTION 23

Hemorrhage Due to Portal Hypertension

HEMORRHAGE FROM VARICES in the lower esophagus and fundus of the stomach is one of the serious sequelae of portal hypertension. This type of hemorrhage is particularly important, since the differential diagnosis of the source of upper gastrointestinal hemorrhage prior to operation may be hard or impossible and the control of hemorrhage from varices technically difficult.

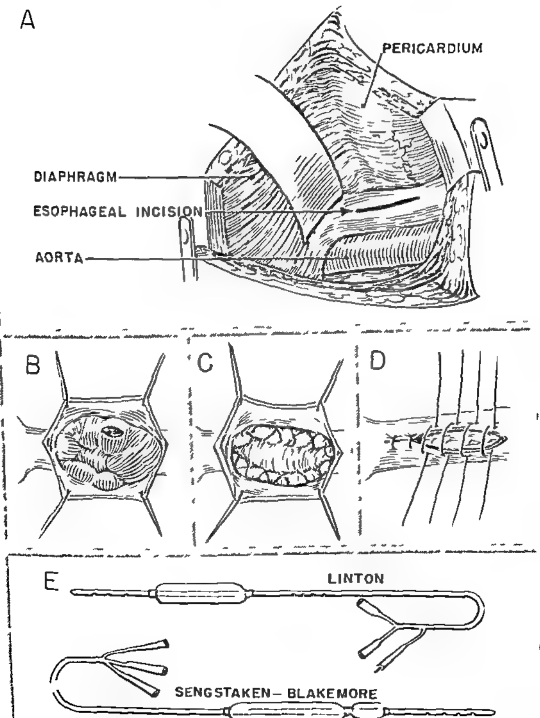
Measures that may be employed for the control of hemorrhage include (1) tamponade of the varices by balloon-tipped tubes, (2) direct ligation of varices, (3) splenorenal shunt, (4) portacaval shunt, and (5) Tanner's operation.

There is no unanimity of opinion so far as the indications for each of these procedures is concerned. Since the mortality rate for any such operation is high, chiefly because of associated hepatic insufficiency, the criteria for the selection of a proper operation are in a state of flux. In this section the present method of treatment in the Massachusetts General Hospital will be described.

DIFFERENTIAL DIAGNOSIS.—The diagnosis of hemorrhage from varices is based upon the various stigmas of cirrhosis, such as enlarged liver or spleen, the presence of spider angiomas and the demonstration of varices by emergency x-ray examination or esophagoscopy. An elevated serum ammonia level helps to confirm the diagnosis. *Continuation of bleeding from the catheter after inflation of Sengstaken or Linton balloons indicates that bleeding arises from the stomach rather than the esophagus*, but this method of differentiation is not always satisfactory.

Since in the Massachusetts General Hospital the preferred emergency operation for this type of hemorrhage is ligation of varices via

PLATE 81


A
PERICARDIUM
DIAPHRAGM
ESOPHAGEAL INCISION
AORTA
B
C
D
E
LINTON
SENGSTAKEN– BLAKEMORE

Ligation may be accomplished by either the transthoracic or the abdominal approach The latter was employed by Crile and more recently has been recommended by Stuart Welch The transthoracic operation has been preferred in the Massachusetts General Hospital and will be illustrated here

A.—Through a left thoracotomy incision in the eighth interspace or bed of the resected rib the esophagus has been exposed It is now opened just above the diaphragm through a vertical incision about 4–5 cm long Occasionally large veins about the esophagus will need suture at this stage

B.—Huge varices have been exposed with a fresh thrombus in an open vessel

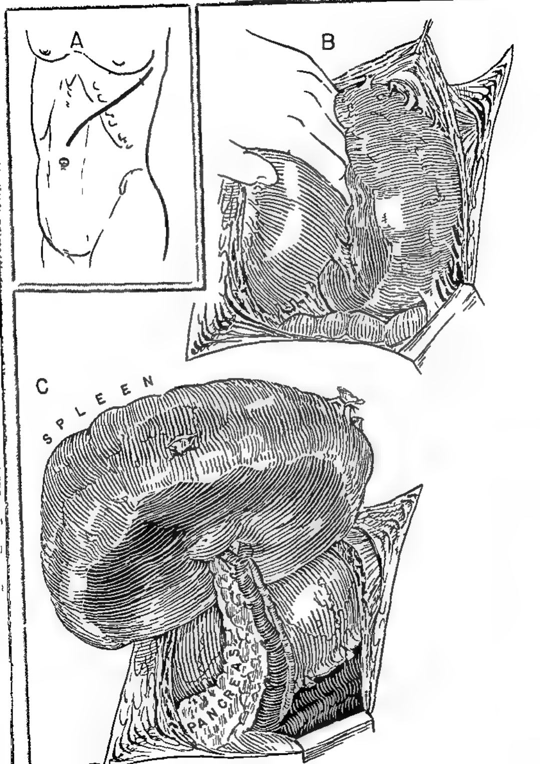
C.—The varices are now oversewn by running sutures of 00 chromic catgut controlling hemorrhage and obliterating the varices usually three varices are present and will require suture

D.—Closure of the esophagus may be done in either a vertical or horizontal fashion if the incision is short Long incisions require vertical closure This is done in three layers with interrupted 0000 silk Although bulky varices may make this closure somewhat difficult it must be done meticulously

E.—Two of the nasogastric balloons that may be used for the emergency control of hemorrhage from varices are shown The Sengstaken tube carries two and the Linton tube a single balloon After insertion into the stomach the balloons are inflated and by traction that is maintained at 2 lb are pulled into the cardia

If an abdominal approach is used the lower esophagus is mobilized, as shown in Plate 40 A tourniquet improvised from a rubber wick or Harrington tape may be used to draw down the esophagus and to occlude the esophageal plexus The esophagus is then opened by a vertical incision and the veins sutured Closure is done in a vertical fashion

PLATE 82



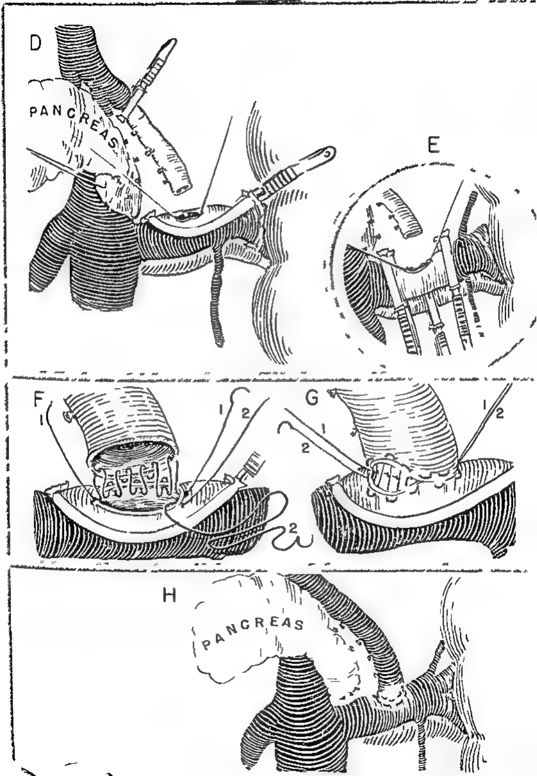
A—A thoracoabdominal incision is necessary for adequate exposure This may be made through the eighth or ninth interspace and is carried from the midline back to the left anterior axillary line

B—The spleen is exposed after partial division of the diaphragm Dissection of the spleen often is difficult because of dense adhesions binding it to the diaphragm These adhesions contain large blood vessels which require clamping and ligature to avoid excessive blood loss At times a section of the peritoneum may be elevated with the spleen The lienocolic ligament is divided and the gastrocolic omentum separated from the stomach and colon The spleen can then be lifted forward gradually demonstrating the vasa brevia During all of this dissection great care must be taken to avoid damage to the spleen or splenic vessels since it is easy to traumatize the splenic vein

C—The spleen and the tail of the pancreas have been mobilized and drawn forward The vasa brevia have been divided and ligated The splenic vessels are now mobilized with extreme care Before removal of the spleen the artery is clamped so that as much blood as possible is returned to the circulation Thereafter the splenic vein may be clamped in the hilum and splenectomy done Ligation and division of three or four pancreatic veins that drain into the splenic vein may be carried out either before or after splenectomy this maneuver must be done with great care since these veins are very short and delicate They are dissected individually doubly tied and then divided between the ligatures

[Splenorenal shunt *continued on page 382*]

PLATE 82



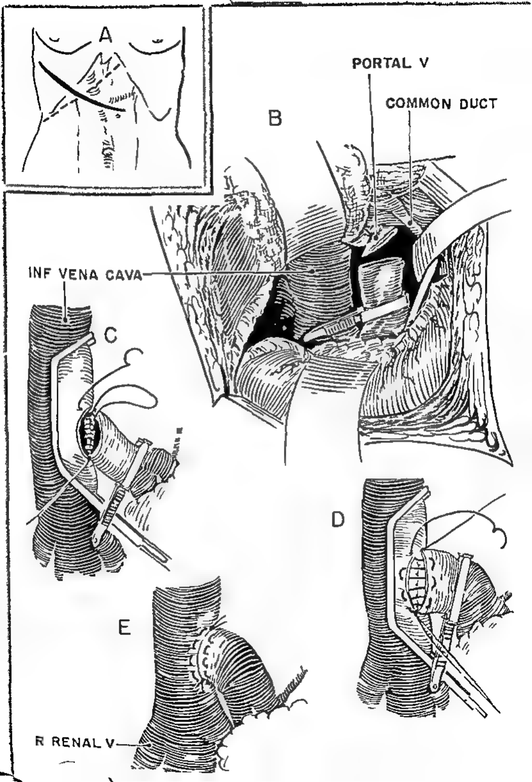
D—In this figure the entire venous system is shown for orientation purposes, though normally only the splenic vein pancreas kidney and renal vessels will be visible at this stage A 5 cm length of splenic vein has been mobilized and bleeding controlled by a bulldog clamp The kidney need not be mobilized completely if the renal vein can be developed sufficiently to apply a curved bulldog clamp that only partially occludes the lumen Other curved clamps (Janeke or Potts) may be used on the renal vein in place of the bulldog but the handles are long and will interfere with the anastomosis

E—In this alternate method, the renal vein is small and complete occlusion is necessary to make the anastomosis Under these circumstances the entire kidney must be mobilized so that a bulldog clamp may be placed on the renal artery During this dissection care must be taken to avoid the ovarian (or spermatic) vein and the adrenal vein The period of occlusion of the renal circulation must not be over an hour

F—The anastomosis is made by a layer of 5-0 arterial silk mattress sutures one of which is used in the posterior row (*1*) and one on the anterior (*2*) The renal vein has been opened by a longitudinal incision suture *1* is introduced at the right end of the anastomosis and tied It is then continued by a stitch that everts the intima This is the exact opposite of the Connell stitch used for intestinal anastomosis since the loop is placed on the outer rather than the inner side The whole posterior row is inserted before the stitch is tightened Then suture *2* is inserted and tied and the ends of *1* and *2* are tied together

G—The anterior row is inserted in a similar manner the suture tightened and then the ends of *1* and *2* are tied together

H—At the conclusion of the operation blood should be seen flowing through the anastomosis A few interrupted sutures may be necessary to complete hemostasis The tail of the pancreas often requires excision since it may have been traumatized


A
B
PORTAL V
COMMON DUCT
INF VENA CAVA
C
D
E
R RENAL V

A—Many incisions are available for this procedure A long thoracoabdominal incision may be made as shown in the diagram A long right subcostal incision is easier and if the portal vein is not overlapped by a large liver will be satisfactory

B—The common duct and hepatic artery have been separated from the portal vein and retracted to the left The duodenum and head of the pancreas are drawn downward The inferior vena cava is mobilized at the level of the renal veins The portacaval anastomosis may be side to side or end to side A side to side anastomosis may reduce the hepatic blood flow to an undesirable level since it may shunt hepatic arterial supply from the liver Consequently an end to side anastomosis is preferred Here the portal vein has been divided and the proximal end ligated in the hilus of the liver

C—The vena cava now can be partially occluded by any of several special clamps In this illustration a Satinsky clamp is shown though a curved Potts clamp also is good The anastomosis is made by the technic illustrated in Plate 82 In this sketch the posterior row is being completed

D—The anterior row is made in a similar fashion

E—Completion of the anastomosis After release of the clamps bleeding usually persists for a few moments and additional sutures may be necessary As few as possible should be used since they may compromise the anastomosis

APPENDIX 2

Postoperative Diets

DIET AFTER GASTRIC ANASTOMOSIS

Day of operation	nothing postoperatively
1st day	30 cc water/hour
2d day	60 cc water or gruel/hour
3d day	90 cc water or gruel/hour
4th day	120 cc milk malted milk cream or gruel every 2 hours
5th day	180 cc of 4th day diet every 3 hours add crackers
6th day	180 cc every 3 hours add cream soup eggnog custard and soft cooked cereals
7th day	240 cc every 3 hours add baked potato ice cream butter and toast
8th day	same as 7th day
9th day	6 meal bland diet

DIET AFTER ESOPHAGEAL ANASTOMOSIS

1st day	nothing postoperatively
2d day	30 cc clear fluids/hour
3d day	60 cc clear fluids/hour
4th day	90 cc clear fluids/hour
5th day	120 cc clear fluids/hour
6th day	120 cc /hour add milk malted milk, gruel egg nogs junket and cream soup
7th day	same as 6th day
8th day	150 cc /hour of same diet
9th day	same as 8th day
10th to 14th days	6 equal feedings add ground meat fish cheese poached or soft boiled eggs strained and cooked vegetables strained fruit juices

APPENDIX 1

Normal Laboratory Values

BLOOD

Determination	*Normal Value*	*Material Analyzed*
Amylase	15–45 units/100 cc	Serum
Blood volume	5–7 L	Blood
Carbon dioxide content	26–28 m Eq /L (20–26 m Eq /L in infants and children)	Serum
Chloride	100–106 m Eq /L	Serum
Hemoglobin	14–16 Gm /100 cc	Blood
Nonprotein nitrogen	15–35 mg /100 cc	Serum
Potassium	3 5–5 0 m Eq /L	Serum
Protein		
Total	6 0–8 0 Gm /100 cc.	Serum
Albumin	4 5–5 5 Gm /100 cc	Serum
Globulin	1 5–3 0 Gm /100 cc	Serum
Prothrombin time	Given with each analysis	Plasma
Sodium	136–145 m Eq /L	Serum

GASTRIC CONTENTS

Determination	*Normal Value*
Acidity fasting free	0–30 units (or m Eq /L.)
Acidity fasting total	10–50 units
Acidity after fasting test meal free	20–60 units
Acidity after fasting test meal total	40–60 cc
Volume fasting	20–100 cc
Volume 12 hour night output	580 units (average)

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